ENVIRONMENTAL IMPACT STATEMENT

final

ENVIRONMENT

KAIPAROWITS

ENERGY

United States
Department of the Interior

CHAPTERS III, IV, V, VI AND VII

KAIPAROWITS

ENVIRONMENTAL IMPACT STATEMENT

CHAPTER III

ENVIRONMENTAL IMPACTS OF PROPOSED ACTION

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SUMMARY

This chapter considers the expected environmental impacts of the project as it is proposed. It presents all predictable impacts, including those which will not outlive the construction phase. It includes impacts that will be mitigated by measures inherent in the project design, such as installation of particulate removal equipment. Additional, optional mitigating measures and residual or unavoidable impacts are set forth in Chapters IV and V.

Impacts are aggregated by resource and by Kaiparowits Plateau, transmission system, and limestone quarry impact areas. The Kaiparowits Plateau impact area includes mines, power plant, new town and new highway. The transmission system impact area also includes the communications system. Each of the impact areas includes all support facilities. When added together, impacts from each of these resources and areas would not result in new or different impacts from those individually described.

Climate

No significant impacts on climate have yet been measured in the southwest as a result of emissions from large coal-fired power plants and no significant impacts on climate would be expected from the Kaiparowits power plant or the associated transmission system.

Air quality

The participants in the Kaiparowits power generating plant propose 99.5 percent control of particulate emissions, 90 percent control of sulfur dioxide (SO_2) emissions and control of nitrogen oxides (NO_x) to meet federal emissions standards. Calculated emission rates based on these efficiencies indicate that applicable emission control standards would be met or surpassed.

. Oil fog plume simulation studies in November 1973, and a coordinated smoke and fluorescent particle tracer study in May 1974, did not reveal a situation leading to a significant impact of plant emissions on surrounding terrain under unstable, neutral or slightly-stable conditions. Topography of the Kaiparowits site, characterized by irregular terrain, appears to contribute to more rapid plume dispersion than would be predicted over flat terrain.

More restrictive emission dispersion conditions, potentially responsible for higher ground-level concentration, were studied using Intercomp, a three-dimensional, numerical model, the NOAA model, the EPA model (C4M3D) and the TVA model. "Stable," "limited-mixing," and "inversion-breakup" meteorological conditions were examined, using available data. With the Intercomp model, the highest ground-level concentrations of SO_2 resulted from "inversion-breakup" or fumigation conditions, with "limited-mixing" giving the second highest level. Three-hour, 24-hour, and annual ground-level concentrations were determined to be 187, 46, and 2 micrograms per cubic meter ($\mu g/m^3$) respectively, or .083, .020, and .0009 parts per million (ppm). These predicted values would be below the allowable increases defined in the Federal Prevention of Significant Air Quality Deterioration Regulations (PSDR) for a Class II area. The Kaiparowits Plateau impact area and surrounding region is presently designated as a Class II area in the PSDR. A Class II area is one in which air quality deterioration normally accompanying moderate, well-controlled growth would be considered insignificant. These predicted values would also be below ambient air quality standards established for protection of human health and welfare.

The highest ground level concentrations of SO_2 predicted by the NOAA and C4M3D models were for the stable atmosphere condition. Concentrations from the NOAA model were 252 and 58 $\mu g/m^3$ for the 3-hour and 24-hour levels. C4M3D calculated 142 and 47 $\mu g/m^3$ for the 3-hour and 24-hour case. These levels are within the allowable Class II incremental increase which is allowed under the PSDR.

There is presently experience to indicate that 99.5 percent particulate control can be obtained now and with even greater certainty with improving technology available by 1980. The design value, however, in and of itself, does not provide assurance of that fact. Calculated emission rates, ambient air concentrations, and applicable air quality standards and contracts for Kaiparowits were compared to determine the minimum enforceable control that would be required. It was determined that 82.8 percent control of SO_2 would be required to meet the PSDR, 99.1 percent control of particulates would be required to meet the PSDR, and 32.5 percent control of NO_x would be required to meet the New Source Performance Emission Standards. These emission levels would result in the release of 3.72 tons per hour of SO_2, 10.4 tons per hour of NO_x, and 1.05 tons per hour of fly ash.

The Kaiparowits proposal would fall under the purview of the Prevention of Significant Deterioration Regulations which is the single most important factor to be considered. The proposed site at Fourmile Bench lies within a 100-mile radius of a number of National Parks, National Recreation Areas, National Monuments, and National Forests, all of which have the potential for redesignation to a Class I area in which practically any change in air quality would be considered significant. The National Park Service (1976) feels that the operation of the Kaiparowits plant would result in air quality impacts that are adverse to the legislative purpose of Glen Canyon National Recreation Area and Bryce Canyon National Park. The relevant extracts from the appropriate legislation are as follows:

> Glen Canyon NRA was established "...in order...to preserve scenic...features contributing to public enjoyment of the area...." (86 Stat. 1311)
>
> Bryce Canyon NP was initially established as Utah National Park to be managed"... subject to the provisions of the Act of August 25, 1916, entitled "An Act to establish a National Park Service, and for other purposes." ..." (43 Stat. 593)

> The Act of August 25, 1916 states that parks under the administration of the National Park Service shall be managed "...by such means and measures as conforms to the fundamental purpose of the said parks, monuments, and reservations, which purpose is to conserve the scenery and the natural and historic objects and the wildlife therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations." (39 Stat. 535)

The Lake Powell Recreational Area (within 20 miles of Fourmile Bench), Bryce Canyon National Park (within 30 miles), and Capitol Reef National Park (within 60 miles) are three components of the National Park system presently being studied by the National Park Service and EPA to determine whether or not to recommend reclassification from Class II to Class I areas. If these components were to be redesignated as a Class I area, it is possible that Kaiparowits power plant emissions would cause the Class I allowable incremental increases to be exceeded. Such a condition would make the proposed site and the present scope of the power plant unacceptable. Should such a redesignation be made, additional evaluation of the projected air quality levels and their impact would be necessary with careful consideration of meteorological conditions and persistence and corresponding plume transport.

Calculated ambient air concentrations of trace elements including mercury are close to or below background measurements made at Page, Arizona and other areas and not expected to have an adverse impact. Long-term accumulation of trace elements has a potential impact on the environment if accumulated in sufficient quantities, but distributive pathways through the ecosystem are not well defined. Based on the trace element analysis of Kaiparowits coal, predicted emission rates, and deposition amounts, trace elements are not expected to accumulate in sufficient quantities to have significant environmental impacts. Mercury concentration in some of the larger predatory fish in Lake Powell has approached or exceeded the current safe consumption standards so that any additional source of mercury input to the Lake Powell ecosystem needs careful examination. Based

on estimations of mercury emissions from the proposed Kaiparowits plant and the predicted atmospheric behavior of the element, it is expected that atmospheric mercury would be injected into the Lake Powell ecosystem by the Kaiparowits plant. The input of natural mercury in the environment would however, exceed the contribution from the coal-fired power plant. Mercury accumulation in Lake Powell is estimated to be between 1 and 27 percent of the total added annually by natural sources depending upon the assumptions made. Radioactive elements released from the stacks are predicted to be low in concentration, and significantly below Atomic Energy Commission guidelines for protection against radiation.

Plume opacity is a measure of plume visibility. Studies conducted at the Four Corners power plant relating particulate emission rates and plume opacity have indicated that, with the design and operating conditions predicted for the Kaiparowits generating station, maximum opacity would be 11 percent, below the 20 percent opacity limitation. Particulate emission rates greater than design quantities could lead to a more opaque and visible plume as has been the experience at Navajo.

Reduction in visibility is one of the most dramatic effects of air pollution. Particulate emissions, and conversion of sulfur and nitrogen oxides to particulate nitrates and sulfates, would have an impact on visibility. Studies by Bechtel Corporation using ground level plume concentrations indicate that with proposed emission controls operating at design specifications under neutral meteorological conditions (which is a predominant situation at Fourmile Bench), visibility could be reduced approximately 9 to 19 miles when looking along the axis of the plume. The study indicated no significant decrease in visibility under these conditions when looking across the plume. More limited dispersion conditions, such as occur during the winter, could lead to greater visibility reductions.

The Bechtel (1974) studies indicate that brown discoloration of the plume would be periodically visible, the intensity being proportional to the concentration of nitrogen dioxide in the air. Williams (1975) indicates that during low wind speed, neutral or slightly stable conditions, the Navajo plume can be tracked visually because of the apparent brown color of the plume. The Arizona Department of Health Services indicates there have been numerous observations of the yellow-brown haze in the vicinity of the Navajo power plant, but the frequency, duration, or extent have not been documented. Because proposed control measures for nitrogen oxides are similar for Kaiparowits, incidence of brown haze from nitrogen dioxide could become commonplace in the area.

Impacts from cooling tower water vapor would include the aesthetic intrusion of fog plume, localized ground level fogging and icing during cold or humid periods, and entrainment and dispersion of dissolved salts from cooling tower water.

Predicted impacts of emissions from the traffic on the proposed access roads and new highway for the Kaiparowits proposal have been examined both for the immediate vicinity of the road and on a larger regional basis and found to be minimal.

Impact on air quality as a result of mining activities such as coal processing and transfer, and employee travel to and from the mine would be minimal. Fugitive dust from exposed and unstabilized soil surfaces, the limestone calcining process, fly ash handling and vehicle travel, have the potential for impact on aesthetics and visibility.

Air quality degradation along the transmission lines would result mainly from fugitive dust generated by surface disturbance and road construction. Accidental burning of vegetation removed from the transmission corridor would cause a temporary adverse aesthetic and air quality impact. The production of ozone by energized transmission lines is not expected to be significant. Noise

disturbance would come from construction, aircraft patrol flights and corona discharge along the transmission lines.

Air quality at the proposed limestone quarry would be affected by fugitive dust from drilling, cutting, blasting and loading operations. The impact is expected to be confined to the quarry site. Noise generated by drilling, cutting, blasting and loading would affect adjacent areas as well.

Exhaust emissions from trucks would affect air quality, but would be dispersed and diluted near the source under most meteorological conditions.

Geology and topography

Impacts on topography would result from earth moving activity in the Kaiparowits Plateau impact area. About 9,460 acres would be disturbed during construction. Of this, 7,320 acres would be permanently occupied after construction.

Additionally, subsidence of mined-out lands would affect the topography over wide areas. Tentative exploration and mining proposals indicate that the four mines would affect an area approximately nine by seven miles (63 square miles). Calculations indicate a subsidence varying up to 10 to 14 feet at the center of the area and feathering out toward the edges.

Geology would in turn be impacted by rupturing of formations and removal of coal. With current technology, only about 50 percent of the coal would be recovered. Remaining coal would be left in the ground. Excavation for evaporation ponds and reservoirs, construction of access roads and new highway, mining of aggregate for construction uses, and removal of surface material to create storage areas would also impact geology.

Topography along the transmission corridors would be only slightly modified by construction of any one of the proposals. Topography in rough terrain would be permanently modified by mining sand and gravel (2 acres), permanently modified at tower sites (12-13 acres), temporarily modified at crane pads (42-47

acres) and either temporarily or permanently modified along access roads (several hundred acres).

The removal of 13 million tons of material at the limestone quarry would create a pit 30 feet deep covering 130 acres.

Soils

Soils in the Kaiparowits Plateau would be disturbed by the generating station and support facilities, new highway, coal mine and support facilities, new town and aggregate sites. About 9,460 acres would be disturbed during construction, whereas an estimated 7,320 acres would be occupied by some type of improvement after construction is completed. The probability of seeding success on the disturbed areas of the power plant, portions of the water pipe line, and the new town would be 3 to 5 years out of 10 years under natural conditions. The remainder of the disturbed areas would have a seeding success of less than 3 years out of 10 years.

The annual change in sediment deposition in Lake Powell is insignificant. It amounts to less than 0.5 percent increase (+ 1.9 acre-feet) during construction and to less than 0.25 percent decrease (0.5 acre-feet) after construction is completed. The change in sediment deposition into the Paria River is also insignificant.

The salt drift from cooling towers could adversely affect the growth of surrounding sagebrush and juniper. An estimated 140 acres would be affected after 5 years of operation and 1,375 acres would be affected after 50 years of operation. Vegetative cover on the 1,375 acres could be reduced by up to 70 percent.

Trace elements from stack emissions would be deposited into the soils within a 30-mile radius of the power plant. The trace elements include arsenic, barium, boron, flourine, lead, mercury, selenium, titanium and vanadium. After 50 years of operation fluorine concentrations would reach 22 ppm. Other trace

elements would vary from 0.008 ppm for lead to 0.55 ppm for titanium. Concentrations for these trace elements in the fly ash-scrubber residue pile would be 20 to thousands of times greater than deposited in the soils. This pile would become a source of pollution to Lake Powell some years after abandonment, when the 1 foot of topsoil has eroded off the steep side slopes and control structures no longer function.

An estimated 8,235 to 10,575 acres would be disturbed by the proposed transmission system. Removal of vegetation would cause increased exposure of soils and movement of construction equipment would cause increased compaction of soils. These effects would increase the estimate of sediment yield by 28.5 acre-feet for the first year after construction. This amounts to .038 inch of soil over the disturbed area. Sediment yield would decrease each year as ground cover is established. Other effects of exposure and compaction would be a decrease in the rate of water infiltration and an increased runoff rate.

Revegetation may not occur during the life of the project for 72 percent of the lands disturbed in the arid and semiarid zones. About 10 years may be required to reestablish plant growth on the remaining 28 percent of the disturbed lands.

A total of 240 acres would be affected by the limestone quarry operation. The probability of seeding success on the soils involved would be more than 7 years out of 10 under natural conditions.

The construction and operation of the limestone quarry would cause an insignificant increase in annual sediment deposition (less than 0.04 acre-foot) in Piute Reservoir.

Water resources

A total of 59,690 acre-feet per year of water would be used by the proposed project during its projected 35-year life. An estimated 50,000 acre-feet per year would be withdrawn from Lake Powell, reducing Utah's remaining

allotment of Colorado River water by about 10 percent and making the water unavailable for other uses. Applications would be filed to appropriate about 9,690 acre-feet per year of ground water from local aquifers near Lake Powell for the proposed new town. This could lead to litigation to determine if all or part of the water applied for is Lake Powell water in bank storage, with appropriation requiring a water service contract with the Bureau of Reclamation. Withdrawal of the 9,690 acre-feet per year would reduce natural inflow of ground water to Lake Powell by nearly the same amount, and would also conflict with existing ground water rights in the Glen Canyon City area.

Withdrawal and depletion of 50,000 acre-feet per year of water from Lake Powell would have a net salt-concentrating effect on the Colorado River compounding the existing Colorado River salinity problem. According to the U.S. Bureau of Reclamation, withdrawal and depletion of 50,000 acre-feet per year from Lake Powell would increase the salinity of the Colorado River at Imperial Dam by an estimated 2.1 milligrams per liter (mg/ℓ). It has been estimated that for each mg/ℓ increase in salinity in the lower basin, an annual damage of $230,000 could occur as expressed in terms of agricultural, municipal and industrial use. Projects completed under the Colorado River Water Quality Improvement Program would offset to some degree increased salinity in the river resulting from the proposed project. Depletions, by coal mining, of relatively poor quality ground water that flows to Lake Powell would also offset slightly the project related salinity increases in the Colorado River.

Mercury and other volatile trace elements would be deposited from smoke stack emissions onto local drainage basins immediately tributary to Lake Powell. Some of the mercury and other trace elements would eventually be carried to Lake Powell by overland runoff. This would increase the amount of mercury available for bioamplication. It could adversely effect the ecosystem in the lake and degrade sport fishing.

Removal of 420 million tons of coal during the projected 35-year amortized life of the proposed project, and subsequent land subsidence in the mined-out area, would disrupt perched aquifers and probably deplete the flow of some seeps and springs that provide water for livestock and wildlife. Fracturing of rocks by mining and subsidence would create connecting flows between fresh and saline-water aquifers, thus generally deteriorating local ground-water quality.

The proposed project would increase long-term mean annual runoff from the Kaiparowits Plateau impact area to Lake Powell and the Colorado River by about 800 acre-feet. This would be an increase of 1.33 percent of the estimated mean annual runoff from the Kaiparowits Plateau impact area, and the effect on the long-term average annual gauged runoff in the Colorado River at Lees Ferry, Arizona would be negligible.

The combined effect of the proposed project on present water uses in the area would be the possible conflicts with existing water rights associated with the proposed new town supply. The anticipated influx of population in the general area could require expansion of existing local town water supplies by about 34 acre-feet a year, and waste water treatment facilities proportionably. The principal use of ground water within the Kaiparowits Plateau impact area is for livestock and wildlife. Depletion of local springs by the mines or contamination of a spring by leakage from the evaporation ponds would eliminate or reduce productivity of the area for livestock and some species of wildlife.

The existence of the ash disposal area, mine tailings pond, and evaporation ponds long after the projected 35-year life of the proposed project would be a long term source of pollution to local springs, Lake Powell and the Colorado River.

Impacts to water resources along the transmission corridors, resulting from construction of any one of the proposals, could include alteration of springs, depletion of small ground or surface water supplies, and pollution of perennial

streams. Water used for construction would neither significantly increase regional uses nor decrease regional supplies. However, local overuse could deplete small ground or surface water supplies. Pollution of perennial streams would occur if waste materials were accidentally spilled or indiscriminately dumped. Increased sediment loads in perennial streams, attributable to construction, would probably not be measurable.

Impacts of the proposed limestone quarry on water resources would be felt most strongly in the Sevier River basin. An estimated 2,000 gallons per day (about 2 acre-feet per year) of ground water would be required to operate the quarry. The ground water would have to be pumped from an aquifer in the Sevier River basin. Because the Sevier River is fully appropriated, application to appropriate the needed 2,000 gallons per day would conflict with existing water rights.

Construction of the proposed quarry and related facilities would increase runoff from the area effected from an estimated 16 to 16.4 acre-feet per year. After the projected 35-year life of the proposed project, average annual runoff from the effected area would increase by about 2.1 acre-feet.

The workers needed to operate the quarry, and their families could increase the combined municipal water needs of Antimony and Topic by an estimated 41 percent.

The impact of the proposed quarry operation on ground water quality would be negligible if the quarry does not intersect the water table exposing the ground water directly to potential contaminants. Blasting and drilling associated with the quarry operation could change the rate of discharge of Tom Best and Reynolds springs which are used for watering wildlife, livestock and for local irrigation.

Vegetation

An estimated 9,460 acres of vegetation on the Kaiparowits Plateau impact area would be disturbed during construction. Most of the vegetation would be pinyon-juniper, mixed shrub grass-scattered juniper, and desert shrub grass communities. Of the 9,460 acres, approximately 7,320 would be permanently lost to project installations.

The Kaiparowits area has been extensively inventoried for individual species including the occurrence of endangered and threatened plant species. Astragulus malacoides (endangered) and Peteria Thompsoniae (threatened) occur in the Nipple Bench and Fourmile Bench areas. Euphorbia nephradenia and Vigviera soliceps (endangered), and Phacelia demissa var. heterotricha (threatened) occur in the East Clark Bench area. These species could be disturbed by construction activities.

The major air pollutant toxic to plants emitted from the power plant would be sulfur dioxide (SO_2) along with nitrogen oxides (NO_x). Maximum calculated ground-level concentrations of these gases, considering both proposed emission controls and minimum enforceable control levels under present air quality constraints, would be below concentrations which have been established for protection of vegetation from injury.

The projected large influx of people and their associated business and recreational activities could severely damage vegetation in many areas, (particularly on the more fragile habitats associated with the Dakota sandstones and Tropic shales). Although difficult to quantify, this could reasonably be expected to be a greater impact than removal of vegetation by construction activities.

Investigators have demonstrated that aquatic vegetation in Lake Powell is accumulating mercury that occurs naturally in the watershed. Mercury released by the proposed power plant could also enter Lake Powell and accumulate in the

plant life, where it is subject to further concentration by fish and other aquatic organisms that feed on these plants.

Long-term accumulation of salts from cooling tower drift, has been calculated to cause reduced vegetation growth and vegetative cover on an estimated 1,374 acres in close proximity to the cooling towers. The occurrence of a lower drift rate than projected by design specification which has been experienced at the Navajo power plant could result in additional evaporation pond area, requiring more land use and removal of additional vegetation. This vegetative loss could be offset, at least in part by reduced vegetative loss from the lower salt drift rate.

An estimated 8,235 to 10,575 acres of vegetation would be disturbed and about 1,350 to 1,890 acres would be occupied along the proposed transmission lines, depending on which of the three proposals is considered. Protected, rare, threatened, or endangered plant species occur along the proposed lines in Arizona, Nevada, Utah and California. These species could be disturbed by construction activities. If the project were to be approved, transmission corridors and communication sites would have to be surveyed for the presence and protection of these species.

An estimated 360 to 500 animal unit months (AUMs) of livestock forage would be lost annually during construction, depending on the proposal. After construction about 53 to 83 AUMs would be lost annually depending on the proposal chosen. This loss of AUMs would gradually be reduced as revegetation occurs on the disturbed areas.

An estimated 240 acres of vegetation, consisting primarily of pinyon pine and juniper with scattered ponderosa and bristlecone pine, would be permanently lost at the proposed limestone quarry. At least one plant species on the federal list of endangered plants occurs in this area.

Wildlife

Approximately 7,320 acres of wildlife habitat, of various types and levels of productivity, would be permanently eliminated by the power plant, coal mine, water lines, highways, and new town. An additional 1,375 acres would be gradually altered over a period of 50 years by cumulative salt drift from cooling towers. About 2,600 acres of this combined permanent loss would be pinyon-juniper woodland, capable of supporting about 30 mule deer year-round and 90 seasonally. About 3,700 of the acres permanently eliminated would be desert shrub and grassland habitat in historic antelope range where a number of the animals have been released in an attempt to reestablish a herd. The project would reduce the likelihood of success in this attempt. Other species occupy other parts of the total habitat to be lost.

An additional 2,140 acres of various types of habitat disturbed during construction would be lowered in productivity. Recovery would be slow, requiring many years in some cases.

There would be danger that emissions of the Kaiparowits power plant would add an estimated 704 pounds of mercury annually to the naturally high mercury load of the Colorado River and to mercury from the nearby Navajo generating plant. This could jeopardize the sport fishery of Lake Powell through mercury contamination of game fish some of which already contain mercury concentrations exceeding 500 parts per billion. This is the maximum level now considered safe for human consumption by the Food and Drug Administration. Mercury would be accumulated and retained as sediment at the bottom of Lake Powell, and would be a hazard long beyond the life of the project. The worst impact could be complete loss of the fishery to public use. This would represent an annual loss of about 127,800 fisherman-days at present use levels, or about 217,000 fisherman-days by the end of 35 years based on current trends. A lesser, and perhaps more probable, impact would be a lowering in recreational quality of the fishery. The large game fish

most highly esteemed by the angler would accumulate the highest mercury levels. Therefore, a shift in fishing emphasis toward smaller, less esteemed forage fish could become necessary.

The long-term, cumulative impacts of other toxic elements in plant emissions cannot be accurately predicted. Several, such as selenium and arsenic, can be extracted from the soil by plants in amounts toxic to animals, and are also toxic in an aquatic biome. The acute problems of acid rain caused by sulfur dioxide in humid regions would not be expected, particularly in the short run.

When water level is low in Lake Powell there could be the problem of fish being drawn into the waterline intake.

Outdoor activity of an estimated 13,928 new inhabitants, in a now sparsely populated area, would have a more widespread impact on wildlife than would construction and operational activities of the project. An estimated increase of 13,700 man-days of hunting, 15,000 man-days of fishing, and 40,000 man-days of off-road vehicle use annually could be expected within a 100-mile radius of the new town site. Increased legal hunting, poaching, harassment and inadvertent disturbance would reduce populations of some wildlife species. The high-quality back-country fishing experience now available at the high mountain lakes north of the Kaiparowits Plateau would be lowered in quality by increased human use.

Construction of the proposed transmission system would result in significant secondary impacts on wildlife resources in addition to direct or primary impacts. Primary biological impacts would include actions that directly remove or destroy soil and vegetation. Vegetation in relation to soil productivity is the combination that produces food and cover for animals. Other primary impacts would involve physical destruction of dens and nests located in the soil or vegetation. Secondary impacts would include those resulting from increased human activity made possible because of new access. These would include increased legal and illegal hunting and disturbance and harassment of wildlife.

Major effects on deer and antelope would be the removal of existing vegetation and the increase of secondary successional vegetation. Because secondary successional vegetation is in some cases preferred by mule deer and antelope, these wildlife species would probably increase their use along the proposed transmission line route. This increase cannot be quantified from available data. A long narrow strip of vegetation of an earlier successional stage would create "edge effect" that would benefit these two species. Negative impacts would include increased access for poaching and the aesthetic losses resulting from viewing wildlife against a background of transmission line facilities.

Desert bighorn sheep generally prefer climax grass vegetation with rough, isolated terrain. Little, if any, true climax vegetation remains in the southwest. However, some areas along the proposed transmission line routes retain a preponderance of grasses mixed with forbs and half-shrubs. This vegetative type is important to bighorn survival, and its removal would eliminate valuable forage for a considerable period of time. The climate, topography and soil in most desert bighorn range make revegetation difficult, and normal plant succession is usually slow. Indirect impacts would include increased human disturbance (i.e. human access into the desert bighorn sheep home range and increased hunting and poaching) and the loss of aesthetic quality from man-made structures intruding into a relatively undisturbed habitat. Since lines would traverse such variable vegetative types it would be impossible to quantify expected decreases in bighorn sheep populations.

Removal or disturbance of existing vegetation and replacement by a lower successional stage might increase populations of some prey species utilized by large raptors and mammalian predators.

Towers and power lines provide excellent roosting and hunting perches for raptors; however birds using these facilities suffer increased vulnerability to shooting. Increased access would pose similar problems for raptors and predators as with other species.

During the construction phase, daily and seasonal movements of animals might be blocked or interrupted. The more mobile species would probably not suffer appreciably but smaller animals with small home ranges would be adversely affected. Small animals may die if blocked from important parts of their habitat.

Proposed transmission corridors would adversely impact habitats occupied by the following endangered species: black-footed ferret, brown pelican, southern bald eagle, peregrine falcon, Vegas Valley leopard frog, Moapa dace, woundfin, Colorado River squawfish, Gila topminnow, humpback chub, bonytail chub, Colorado cutthroat trout, and possibly other, as yet unidentified species.

Adverse impacts would result from outright killing of individuals during construction and maintenance activities and/or alteration, reduction, and loss of habitat. However, local impacts would be of greater consequence to the species as a whole because of already reduced numbers or range. Most of these species have become diminished in numbers or range either because critical features of their habitat are already in short supply, or because they are especially vulnerable to man's activities. Therefore, alteration of a relatively small area of critical habitat or introduction of increased human activity could be a significant increment to an already adverse environment.

The impact of a wildlife species becoming extinct would be irreversible and permanent. That particular gene pool would be permanently lost as would future opportunities for scientific study of that species and whatever knowledge this might benefit man's understanding of his environment.

The limestone quarry operation would eliminate 240 acres of diversified wildlife habitat. The proposed quarry is within an area used as winter range for deer and elk. One of the most significant impacts would be the hazard to a nearby colony of Utah prairie dogs, an endangered species. Road construction, if not properly located, could eliminate the colony.

Ecological interrelationships

The development of a large industrial complex and the influx of 14,000 people into the relatively isolated Kaiparowits Plateau would have a definite adverse impact on the fragile desert ecosystem. Natural resources such as wildlife, vegetation, soils, water and air would be adversely affected. The potential for increased mercury passage through the food chains in Lake Powell and contamination of predatory game fish constitutes the major potential aquatic impact. Similar concern exists for other toxic trace contaminants that could also be concentrated in higher life forms.

The greatest impact along the transmission line route would be the alteration of the plant community and the corresponding adverse influence on the animal community.

The limestone quarry impact area would lose 240 acres of vegetation and associated wildlife. Other concerns are potential adverse impacts to the nearby colony of endangered Utah prairie dogs and adverse impacts on two springs important to wildlife and cattle.

Paleontology, archaeology and history

Impacts on paleontological, archaeological and historical resources in the Kaiparowits Plateau impact area would be both direct, from mechanical destruction by construction and mining; and indirect, through disturbance or destruction by unauthorized collectors, vandals, and recreational users. These resources are limited and irreplaceable. Nine or ten archaeological sites in the generating station and coal mine areas would be destroyed and eighy-three similar sites, located in adjacent areas, would be subject to indirect impacts. Paleontological impacts would minimally impact eight fossil sites in the area of the generating station. Paleontological and archaeological surveys are incomplete and sites have not been identified or evaluated for their preservational value and for eligibility to the National Register of Historic Places.

Impacts on the paleontological, archaeological, and historical resources in the transmission system impact area would be both direct, from mechanical destruction by construction and mining, and indirect, through disturbance or destruction by unauthorized collectors, vandals and recreationists. These resources are limited, irreplaceable, and highly vulnerable to ground-disturbing activities. For the most part, they are as yet unidentified, and unassessed for preservation values. Several of the known sites appear to be eligible for inclusion in the National Register of Historic Places. Several archaeological and historical sites, districts, and trails along the proposed transmission system are presently nominated to or included in the National Register.

The eighteen archaeological sites in the area of the proposed limestone quarry would be subject to total destruction. The fossil sites noted in the area are of little scientific value but would also be subject to destruction.

Recreation

Reduced visibility and sky discoloration due to stack emissions would have a high adverse impact on the quality of the recreation experience for millions of tourists who annually visit the nationally significant parks and scenic areas in this region. Visitors touring the proposed new highway, Highway 89, Bryce Canyon National Park (431,000 visitor days in 1973), and Glen Canyon National Recreation Area (1,209,000 visitor days in 1973) would be most severely impacted.

The high visual contrast between the proposed plant and mine structures and the natural environment would create a major intrusion that would adversely affect the visual experiences of tourists traveling the new highway. The quality of the experience of the visitors viewing Grosvenor Arch would be adversely affected by the visual presence of the proposed new highway and the proposed Utah Power and Light power line and substation.

Off-road vehicle use generated by the new residents would have an adverse impact on the 30,000-square mile area. The impact would come in the form of destruction of vegetation, scarring of the landscape, and increase in vandalism. Increased boating use would create the need for additional boating facilities on the southern portion of Lake Powell, and would increase the vandalism in the side canyons of Lake Powell.

All adjacent areas having primitive values would be affected by the increased use and vandalism associated with the new residents. Areas near the population centers would be most heavily impacted, including Paria Canyon Primitive Area, Hackberry Canyon Roadless Area and primitive values in the Glen Canyon National Recreation Area.

The major impact of the proposed transmission system on recreation values would be the visual affect. The proposed towers, contractors access roads, and microwave repeaters could not easily be blended with the natural landscape and therefore would stand out as unnatural intrusions. The following is a summary of the recreation areas which would be directly or indirectly impacted by the construction of the proposed transmission system: Camp Young, Old Government Road, Dominquez-Escalante Trail, Old Spanish Trail, Temple Trail, Old Mormon Trails, Glen Canyon, Echo Cliffs, Cockscomb, Beaver Dam Mountains, Lava Butte-Rainbow Gardens, Coconino Rim, Aubrey and Cottonwood cliffs, Virgin River Recreation Lands, Colorado River, Push Walla Canyon, Paria Canyon Primitive Area, Indio Hills County Park, Edam Hill and Glen Ivy Recreation Vehicle Parks, Irvine and Villa Park Dam County Parks, Santa Ana Mountains, Las Vegas Dunes Recreation Area, Canyon Lake, Virgin Mountains primitive areas, Kanab Creek, Joshua Tree Natural Area, and Sacramento and Highland mountains. In addition to these areas the proposed transmission lines, roads, and other related facilities would intrude upon hundreds of miles of landscape having high scenic value.

Approximately 1,900 miles of new permanent and temporary roads would increase access and open up otherwise remote areas. The use of these roads could cause increased soil erosion, wild life disturbance, off-road vehicle damage, vegetation loss and could introduce an undetermined number of recreationalists into the transmission area.

The proposed transmission system would occupy approximately 3,000 acres of recreation lands. The construction and maintenance activities of the transmission system could tend to degrade the quality of the outdoor recreation experience for the users of the area.

The transmission system would cross and be visible from numerous highways. The impacts would depend on the number of viewers of the transmission system and their ideas and attitudes toward the intrusions created by the transmission system. Along the entire transmission system it is estimated that a daily average of 320,000 travelers could view the lines and roads.

The direct impacts of the proposed actions at the limestone quarry would be minimal; however, the truck-trailer traffic (30 round trips per day) originating at the quarry site would pass through the northeast corner of Bryce Canyon National Park creating a noise and traffic congestion problem that would adversely affect park visitors.

Land use

Construction of the proposal in the Kaiparowits Plateau would temporarily affect land use on about 9,460 acres. Of this total acreage, use of 7,320 acres would be indefinitely altered and ownership and jurisdiction would be changed on at least 9,000 acres. Most of the present uses of the proposed sites and routes would be excluded. Existing and proposed transmission lines through the proposed town site would be potential land use conflicts.

Grazing would be reduced by 740 animal unit months (AUMs) on Fourmile Bench, 40 AUMs in the proposed mining area, and up to 450 AUMs in the new town site area on East Clark Bench. Increased human activity in the impact area would disturb cattle and reduce available forage. Livestock operators would be economically impacted. They could be forced to reduce the size of their herds or even quit the livestock business.

The proposals would require mining of about 1,600,000 cubic yards of sand and gravel and 800,000 to 1,000,000 cubic yards of clay or mudstone. These operations would be major land uses during the construction phases. Marketable deposits of sand and gravel that may underlie the proposed town site could be lost to future use. Possible future deep uranium mining and oil and gas drilling could be excluded from mining, generating station, and new town areas. The proposals would encourage additional coal mining. Direct impacts on agriculture are not expected, but private owners might sell some agricultural land in Kane and Garfield counties, which could reduce hay production and in turn affect cattle ranching.

Movement of heavy loads along existing roads would be only a small increase in net traffic. Such use would damage present facilities, however, and require upgrading or repairs and could be a traffic nuisance. Use of the new highway and other roads during operation would result in increase in traffic, consisting of commuter, industrial, and recreational use. At least 1,600 commuter trips daily would be made. Congestion could result in traffic hazards. Use of existing low-grade roads in the area would increase, mostly for recreational purposes, requiring upkeep of those roads. The proposed highway would provide a north-south route about 23 miles shorter than U.S. 89, and might cause a reduction in income from tourism at Kanab and a need for traveler services in Bryce Valley. It would result in some fuel savings. Public carrier traffic would be affected by greater strain, but services might be improved as a result of increased demand.

Transmission systems and communication sites proposed in Utah, Arizona, Nevada, and southeastern California would occupy predominantly undeveloped, unpopulated desert land. In western California, Las Vegas, Nevada, and Bull Head City, Arizona, the proposed transmission lines would infringe upon residential and recreational lands. An existing airstrip in Glendale, Nevada, would have to be closed because the transmission lines would interfere with the glide path and development of a proposed airstrip in Eldorado Valley, Nevada, would be precluded. Fifty-eight acres of agricultural land would be permanently lost in Riverside County, California. Livestock grazing would be reduced by 75 AUMs along the proposed transmission system.

The proposed action in the limestone quarry impact area would eliminate about 160 acres of livestock forage and displace about 64 of the 646 cattle that presently graze the areas that would be affected. If Prospect and Tom Best springs should be reduced or contaminated by the proposed operations, cattle may not be able to water in the area or other water sources may have to be developed.

Mineral development would become the major land use in the area, and additional limestone mining and mineral exploration in Johns Valley or nearby areas might be encouraged by better access resulting from the proposed operation.

Approximately 50,000 board feet of ponderosa pine would be removed by the quarry operation. About 130 acres of pinyon pine, currently utilized for firewood, would also be destroyed.

If Tom Best Springs were contaminated or reduced by the operations, agriculture near Widtsoe Junction would possibly be terminated or other sources of water would have to be found.

The approximately 30 round trips per day (60 one-way trips) by the limestone trucks would be in addition to the current 40 trips per day by oil tankers from Upper Valley Oil Field along a portion of the route. The loaded

limestone units would be traveling eastward while loaded oil tankers are going west. A traffic "bottleneck" could result as they pass through the steep canyon segment of Highway 12 in the northeast corner of Bryce Canyon National Park. Possible safety hazards would relate to increased truck traffic through Tropic which now has Highway 12 traffic, and more especially Cannonville where the limestone trucks would leave the main highway and travel south through the town's main street. This street currently has minimal light vehicle traffic but would become the new highway.

Socioeconomic factors

The population of the Kaiparowits Plateau impact area would increase markedly if the proposed project were built. The new jobs that would be available during both the construction and operation of the project would attract many workers and their families now residing in other locations. The basic employment at the power plant and coal mines would generate additional jobs to serve the needs of the basic employees and their families. Many of these jobs would also be filled by persons that would move into the plateau impact area from other locations.

Almost all plant and mine employees would reside either in the proposed new town or in Page, Arizona. About 75 percent of the workers and their families are expected to live in the proposed new town. By the tenth year of the project (1985) it is expected there would be 2,354 basic employees residing in the new town and 785 basic employees residing in Page. The population of the new town is expected to reach 9,416 by this time while the population of Page is expected to increase by 3,925 during the same period. The expected 1985 population of Page is 6,029 without the project and 9,954 with the project.

Page may receive more than 25 percent of the population increase if development of the new town is delayed or if quality of the new town facilities

is low. The timing and quality of the proposed new town would also determine the number of families that choose to live in scattered nearby locations rather than residing in the proposed new town.

Timely development of a quality new town would be necessary to avoid the occurrence of a "boom town" during construction of the power plant and coal mines. Planning for the power plant and mines has far exceeded planning and funding for the services and housing needed to avoid development of a boom town situation. However, recent accelerated efforts to compensate for this lost lead time may be adequate so that facilities at the new town would be provided as needed. This current level of planning for the new town suggests that many problems associated with boom towns could be avoided. However, avoidance of such situations could only be maintained with constant surveillance of impending problems and the securing of adequate funding as needed to prevent the growth of such problems. Unless proper control is maintained, socioeconomic problems would occur similar to those experienced in other western locations, such as Campbell County, Wyoming, where rapid population growth caused by development of energy resources created a boom town out of Gillette. Campbell County, when compared with two nearby counties, had divorce rates that were 33 and 85 percent higher; arrests were 67 and 204 percent higher; criminal budget was 51 and 62 percent higher; school dropouts were 26 and 56 percent higher; public drunkenness was 139 and 185 percent higher; and driving while under the influence of alcohol was 350 percent higher than in both counties.

The timely provision of housing and services would be necessary for the establishment of a quality new town. The new town would compete favorably with Page only if housing were provided in a short time after plant construction began. There would be a need for 3,000 new housing units to be built within 5 years.

The distance to the mines from the proposed new town (37 miles) and from Page (56 miles) would create a need for mass transit facilities for commuter convenience and economy. However, no plans for such facilities have been made. This may encourage some workers to rent private lots for their trailers along the roadsides to avoid commuting. Should the available private lots in the area become occupied with makeshift trailer facilities, it would detract from the beauty of the surrounding countryside.

Of the wide variety of services that would be needed at the new town, some would be needed sooner than others. Construction of schools and parks would be a critical need within a few years after construction of the plant begins, whereas construction of some commercial facilities would not be as critical a need because of nearby facilities at Page. Medical facilities in the region may take care of the new demands for a few years but the project would eventually create a demand for new hospital facilities. The major impact anticipated in relation to medical facilities would be a shortage of doctors. The existing law enforcement systems in the region seem to be adequately staffed, but salaries are far below those in Salt Lake City and a high turnover rate may occur when there are new opportunities for employees to work for private industry.

In addition to creating new demands for specific service sectors, industrial development in Utah would contribute to ongoing urbanization. America is seriously short of ideas and methodologies for dealing with adverse effects of the urbanization process. The need to avoid urban degradation is particularly critical in south-central Utah, because it is a scenic area relatively untouched by problems that accompany urban development.

Development of the proposed new town would entail a new socioeconomic composition being placed in the existing sociological scene. Furthermore, it would severely challenge the cultural life of nearby residents. This town would

be unique because it may very well constitute such a political base-line change that a large block of voters in this new town could control local and regional destinies. The new town could become the locus of voting power within the county. Furthermore, because of potential differences in political orientations, it is legally possible that the new town could become the county seat of Kane County, if not of its own newly created county.

The Kaiparowits new town and supporting power plant may become socio-economic liabilities to the county and state governments. A system of financial bonding to support the development of the new town would not alleviate the mutual responsibilities of the county or state governments. If a new community becomes a part of the social system, then a change in one part of the system affects all other parts of the system. Thus, if people in the county and the community would become unemployed because of their mutual attachment to one employer whose presence originally necessitated the new community, then the county would suffer the economic burden. The same is true of problems in environmental health; law enforcement; infectious diseases; pollution control; protection and preservation of farmlands, ranch lands and scenic attractions; and other areas of concern.

There would be socioeconomic differences between the long-time residents of the plateau impact area and new residents attracted by the project. It is very conceivable that subcommunities based on ethnic and racial lines could develop in the overall area. Occupational and professional groups would subdivide as urbanization occurs and clashes would develop because of differences in cosmopolitan and local social ties.

There could be a tension between residents who attempt to maintain "closure" (i.e., maintain established and traditional sociological patterns) and people who have special interests and/or interests in socioeconomic and political factors beyond existing community parameters. To the extent that outsiders

participated in numerous special interest groups, in opposition to traditional life styles, further disruptions would occur. Finally, newly elected representatives may lead into further strains by taking actions and involving themselves in political issues which are not directly oriented towards the interests of the present native local community.

Property tax revenues generated by the plant, mines, and new town would make Kane County one of the richest counties in the state in assessed valuation. These taxes would increase from an estimated $915,400 during the first year of the project to an estimated $24,863,480 during the tenth year of the project. This money could be enough to support the provision of quality services, if a critical backlog of service problems were not created by a sudden population influx. It has proven to be considerably more expensive to correct service problems than to anticipate and prevent them.

Revenues generated in state taxes would also be substantial and would offset some needed state government expenditures. State income tax revenues would increase by an estimated $320,708 during the first year of the project and would increase by an estimated $1,439,445 during the tenth year of the project. However, timing is critical and lack of an adequate implementation schedule would cause residents to undergo hardships until services become available.

Most social and economic impacts resulting from construction of the proposed transmission system in the four-state region would appear to be of short-term duration. The work force for the transmission system would be transient in nature. Little or no on-site hiring would be expected except where the proposed transmission lines would cross Indian reservations. Some Indians could obtain temporary jobs if agreements are reached between participants and the tribes for transmission line right-of-way.

Local governments would collect increased property taxes for improvements erected by the participants, although they would have to provide only minimal services to benefit the transmission system.

Power line construction across some Indian lands may have detrimental impacts on their traditional religious beliefs and customs.

The population of the limestone quarry impact area would increase if the proposed quarry site in Garfield County were developed. It is expected that limestone quarry workers would live in Garfield County if housing is available. The 131 basic employees that would be needed at the quarry by the tenth year of the project would result in a total expected population increase of 587 persons. This would create a demand for about 100 new housing units assuming one-fourth of the labor force were obtained locally. Construction of some permanent housing and planned, landscaped trailer villages in one or more of the small towns in this area could meet the housing needs and promote the economy. However, should makeshift trailer villages be established in Garfield County to meet increased housing needs, the attractiveness of this scenic area could be permanently impaired. Present trailer village restrictions to ensure quality are minimal and even these restrictions are often poorly enforced.

In general, socioeconomic impacts in the limestone quarry impact area would be similar to those in the plateau impact area, particularly problems of population increase, educational facilities, law enforcement, and sociopolitical structures.

If the new highway is built, there would be an increase in retail trade activities in the Cannonville and Bryce Valley area that would necessitate business and new residential construction. Such an impact would possibly be beneficial and not in and of itself too disruptive of area life styles. However, when

combined with the contemplated population growth in the immediate region, the effect of the new highway on transportation patterns would create severe social change impacts on the communities of Cannonville, Tropic, Henrieville, and further north, on such communities as Widtsoe Junction.

Existing water facilities are not presently adequate from an environmental health viewpoint. Additional population would increase water needs creating additional tax burdens and social and cultural impacts. There is no known master plan which indicates a concern for this problem. Since water in the Sevier drainage basin is fully appropriated, increased water use by an expanding population could divert water from existing uses. The impacts of this action are presently unknown.

Impact on the market area

There is no question that increased availability of electricity would influence the pattern and intensity of population growth. Population is expected to grow in the service area, and any increase in available electricity would facilitate that growth. Continued growth could negatively affect existing open space, pollution abatement, and transportation problems.

Most of the population which would be dependent on the power from Kaiparowits would reside in Phoenix, San Diego, and suburban southern California. Although the Kaiparowits project would help meet power needs, it is only a supplement to the total supply that could be expected to have an impact on the market area.

Adequate energy supplies would facilitate urban growth and sprawl in the market impact area. Quality of community life would probably decrease even while per-capita income increased. The increasing concern over air pollution, open space preservation, and mass transit may mitigate the expected degradation to some extent.

CLIMATE

Kaiparowits Plateau impact area

Localized, small-scale influence on temperature, relative humidity, and evapotranspiration would occur if the proposal is implemented. No significant effects on regional climate could be expected.

Transmission system impact area

There are no foreseeable impacts on climate from the proposed transmission system.

Limestone quarry impact area

There are no foreseeable impacts on climate from operation of the proposed limestone quarry and associated facilities.

AIR QUALITY

Kaiparowits Plateau impact area

Clean air is an important part of the aesthetic quality of the canyons and high desert landscape of the Kaiparowits Plateau, and the recreational attraction of Lake Powell and surrounding national parks. Emissions into the atmosphere from coal-fired power plants and associated activities have the potential for major environmental impacts on air quality. Particulate matter is the most conspicuous stack emission, although oxides of sulfur and nitrogen, radioactive nuclides, and trace elements emitted from the stack also have a potential for impact on the atmosphere, the terrestrial environment, and man.

The following section will evaluate probable emissions that would result if the proposed plant were to operate at a 3,000 megawatt (MW) level. Probable emissions of sulfur dioxide, nitrogen oxide and particulates will be compared with national standards for such emissions. The probability of trace-element and radioactive emissions will also be discussed. Environmental impacts result not only from concentration of substances leaving the stack, but also from plume behavior. Smoke-plume simulation and plume-tracer studies, to analyze plume behavior under varying meteorological conditions and to develop a basis for predicting ground-level impact, will be discussed. Simulation studies of plume behavior and ground-level concentrations, using the more limiting meteorological conditions: "stable," "limited mixing," and "fumigation" will also be presented. Such simulation studies (models) necessarily describe a 1-hour condition. In order to extend the simulated time frame to 3 hours, 24 hours, or a year, for comparison with applicable ambient air quality standards, additional assumptions must be made. These assumptions are discussed. Probable air quality impacts also include the aesthetic effects of plume opacity, and the influence of emissions

on visibility. Cooling-tower plume and salt drift will be discussed and probable emissions from the coal mine and other associated activities will be considered.

The Southwest Energy Study (1972) identified a number of potential air pollution problems, including those expected from the proposed Kaiparowits power plant and the existing Navajo plant. These problems would be:

a. Under certain meteorological and terrain conditions, sulfur dioxide emissions may exceed short-term ambient air quality standards. This assumed no emission controls, except the 20 percent control at Four Corners.

b. A lowering of visibility due to emission of particulates and conversion of gaseous oxides of sulfur and nitrogen to particulates.

c. The impact on land animals and plants and water quality by fallout or rainout of airborne pollutants.

d. The release of trace elements (including heavy metals) and radioactive elements to the atmosphere.

These problems will be analyzed as they relate to the proposed Kaiparowits power plant.

Emission and ambient air standards

Air quality standards for stack emissions and ambient air have been promulgated by state and federal agencies in accordance with the Clean Air Act of 1970, as amended. Federal standards are shown in Figures III-1 and III-2. Significant deterioration regulations currently applicable to the Kaiparowits plant are given in Figure III-3. The Kaiparowits Plateau area is designated a Class II area under these regulations. Since the plant site is in Utah but near Arizona, each state's emission and ambient air quality standards have been considered.

FIGURE III-1

Predicted Emissions and Applicable Emission Control Standards for Proposed Generating Plant (3,000 MW 29,680 x 10^6 Btu/hr at 100 Percent Load)

Emission	Without Emission Control (ton/h)		Applicable Standard and Allowable Emission Rate (ton/h)		Abatement Required To Meet Standard (%)		Committed Abatement by Applicant (%)	Predicted Abated Emission (ton/h)	
	[a]Average Coal	[b]Worst Coal			[a]Average Coal	[b]Worst Coal		[a]Average Coal	[b]Worst Coal
SO_2	11.5	21.6	EPA	(17.8)	0.0	17.6	90	1.15	2.17
			Arizona	(11.9)	0.0	44.9			
			[c]Utah	(17.8)	0.0	17.6			
NO_x	15.4	15.4	EPA	(10.4)	32.5	32.5	32.5	10.40	10.40
			Arizona	(10.4)	32.5	32.5			
			[cd]Utah						
Particulate	86.6	116.8	EPA	(1.48)	98.3	98.8	99.5	0.43	0.58
			Arizona	(0.73)	99.2	99.4			
			[e]Utah						
			[f]Dept. of Interior		99.5	99.5			

[a]Sulfur - 0.42% by weight; ash content 7.00%; heating value 10,800 Btu/lb; amount burned 33,000 tons/day.

[b]Sulfur - 0.75% by weight; ash content 9.00%; heating value 10,300 Btu/lb; amount burned 34,600 tons/day.

[c]Air pollution control equipment and processes shall be selected and operated to afford highest efficiencies and lowest discharge rates that are reasonable and practicable. New installations shall control sulfur dioxide emissions as required to avoid exceeding national primary and secondary ambient air quality standards and Federal Standards of Performance for new stationary sources.

[d]No nitrogen oxide emission rate specified.

[e]No particulate emission rate for new sources specified under present regulation.

[f]Water service contract specifies a design efficiency for removal of 99.5 percent of particulate matter with a monthly average not less than 97 percent and a 24-hour average not less than 96 percent.

FIGURE III-2

Federal and State Ambient Air Quality Standards
(In Units of $\mu g/m^3$ and (parts per million))

EMISSION	FEDERAL		UTAH	ARIZONA
	Primary	Secondary		
Sulfur Dioxide				
Annual[a]	80 (0.03)		80 (0.03)	50 (0.02)
24 hour[b]	365 (0.14)		365 (0.14)	260 (0.10)
3 hour[b]		1300 (0.50)	1300 (0.50)	1300 (0.50)
Particulate Matter				
Annual[c]	75	60	d	60
24 hour	260	150	d	100
Nitrogen Dioxide				
Annual	100 (0.05)	100 (0.05)	d	100 (0.05)
Oxidants				
1 hour[b]	160 (0.08)	(0.08)	d	(0.08)

[a] Annual arithmetic mean
[b] Not to be exceeded more than once a year
[c] Annual geometric mean
[d] Federal Standards are quoted in the Utah regulations, but have not been formally adopted by the State.

FIGURE III-3

Area Designations and Allowable Increases in Pollutant Concentrations over the Baseline Air Quality Concentration as Described in the Federal Significant Deterioration Regulations[b]

Pollutant	Class I[a] ($\mu g/m^3$)	Class II[a] ($\mu g/m^3$)	Class III[a] ($\mu g/m^3$)
Particulate matter:			
Annual geometric mean	5	10	*
24-hour maximum	10	30	*
Sulfur dioxide:			
Annual arithmetic mean	2	15	*
24-hour maximum	5	100	*
3-hour maximum	25	700	*

[a]Class I applies to areas in which practically any change in air quality would be considered significant. Class II applies to areas in which deterioration normally accompanying moderate, well-controlled growth would be considered insignificant. All values are allowable increases in pollutant concentrations over the baseline air quality concentration. Areas designated as Class III shall be limited to concentrations of particulate matter and sulfur dioxide no greater than national ambient air quality standards.

Source: Environmental Protection Agency. Air quality implementation plans. Prevention of significant air quality deterioration. Federal Register Vol. 38, No. 235, Thursday, December 5, 1974.

[b]Utah and Arizona also have rules and regulations for air pollution control which require measures to be taken to prevent deterioration of air quality.

Utah

Utah Air Conservation Regulation 9 July 1975, Section 1.3
Air Quality Degradation Regulated:

In areas of present high air quality where measured or estimated ambient levels of controllable pollutants are below the levels specified by applicable standards, any emission of pollutant to the ambient air must be shown to result in pollution levels within applicable ambient air standards and will be prohibited in any case unless shown to be controlled to afford the highest efficiencies and the lowest discharge rates that are reasonable and practicable.

Arizona

State Ambient Air Quality Standards, Section R 9-3-208
Anti-degradation:

These standards shall not be construed as permitting the preventable degradation of air quality in any area of the state.

Stack emissions

Predicted emissions of sulfur dioxide, particulates, and nitrogen oxides from the stacks of the proposed Kaiparowits plant are shown in Figure III-4. The predicted abated emission quantities are based on the applicant's proposal to remove 90 percent of the sulfur dioxide and 99.5 percent of the particulates, and compliance with the nitrogen oxides limitation of 0.7 pound per million British thermal units ($lb/10^6$ Btu) with the plant operating at 100 percent load.

Predicted emissions can also be expressed as pounds per million Btu ($lb/10^6$ Btu) and then compared to federal emission standards as shown in Figure III-4. The data show estimated sulfur dioxide, particulate, and nitrogen oxide emission as equal to or below the most restrictive emission standards.

Depending upon the assumptions made, there could be a difference between emission collector design efficiency and operating efficiency. Experience of the Tennessee Valley Authority (Benson and Corn, 1974) with electrostatic precipitators in the East has shown that only 2 of 15 plants are meeting design specifications. In the Southwest experience with newer equipment using western coals for large plants the size of the proposed Kaiparowits plant is limited. Control equipment at the Navajo power plant (similar in size to the Kaiparowits plant) has been closely monitored by the Air Quality Section of the Arizona Department of Health Services (1975). They conclude:

1. The efficiency of the electrostatic precipitators associated with Units 1 and 2 when "tuned" for compliance testing was 99.6 percent. In "normal operation" the efficiency was 99.1 percent removal of particulate matter.

2. Availability of the control equipment was 97 percent. The 3 percent downtime is due not to malfunction of the precipitators but to malfunction of the boilers and their restarting. The precipitators are not operated until

FIGURE III-4

Estimated Full-Load Emission Data for the Kaiparowits Plant[a] and Comparison with Federal Regulations for New Sources

Emission	Estimated Full-load Emissions ($lb/Btu \times 10^6$)		
	Average Grade Coal	Worst Grade Coal	Federal Regulations for New Plants
Sulfur dioxide	0.08	0.15	1.20
Particulate matter	0.03	0.04	[b]0.10
Nitrogen oxides	0.70	0.70	0.70

[a]Based on 90 percent removal of SO_2, 99.5 percent particulate removal

[b]The water contract with the Department of Interior requires a design efficiency of 99.5 percent removal of particulate matter with a monthly average not less than 97 percent and a 24-hour average not less than 96 percent.

the boilers have reached 20 percent of capacity. This start-up procedure takes 4 to 5 hours and 40 such start-ups have occurred since January 1, 1975 (report dated November 3, 1975).

Electrostatic precipitators in Units 4 and 5 (800 MW each) at the Four Corners plant were designed for 97 percent efficiency and have performed at 97 and 98 percent efficiency (U.S. Dept. of the Interior, 1975). Efficiency at the San Juan plant seems to be much better. The cold side electrostatic precipitator at the Huntington power plant (430 MW) has been operating at 99.5 percent efficiency since start-up in April 1974.

Experience with SO_2 scrubbing equipment has been even more limited because no large scale scrubbers are currently installed in coal-fired power plants. The Cholla power plant in Arizona is presently achieving approximately 90 percent desulfurization with 90 percent reliability using a two module venturi scrubber and limestone scrubber. Recent studies at the Mohave power plant (Bechtel Power Corporation, 1974; Weir et al., 1974; Weir et al., 1975) using a single 170 MW module have shown that 99.5 percent particulate removal and 90 percent SO_2 removal would be feasible at Kaiparowits. These studies also indicate a reliability of the SO_2 scrubber module of about 80 percent. With four modules per generating unit to obtain 90 percent SO_2 removal, and a spare at each, full-time coverage could be expected.

The Utah Air Conservation Committee stated: "The Kaiparowits proposal received concept approval on the basis of submitted specifications which included controls: 99.5 percent for particulate, 90 percent for SO_x and 30 percent for NO_2. At the present time, to the best of our knowledge, these represent the maximum controls technically feasible, thus would meet the State Air Quality Regulation 1.3. (As a matter of fact, we are not convinced that the presently available technology will achieve 90 percent removal of SO_x from power plant

stack gases; however, we anticipate that the technology will be sufficiently improved to do so by the time it is needed for Kaiparowits.)" (See Appendix III-1.).

It is not unreasonable to expect that 99.5 percent removal of particulates with 100 percent availability would be feasible and could be obtained for the Kaiparowits power plant. Design specifications alone, however, do not assure this. For this reason, air quality impacts have been evaluated considering both controls to which the company has committed itself and calculated emission levels which are enforceable by regulation.

Estimated full load emissions resulting from proposed emission control and those which would result from compliance with the Federal New Source Performance Standards are shown in Figure III-5. The emissions from proposed control apparatus would be equal to or significantly lower than these emission standards.

Stack plume dispersion

Ambient concentration of emissions and consequent environmental impacts are dependent not only on the amount of emissions leaving the stack (which have been described), but also on the pattern and degree of stack plume dispersion. Plume dispersion is dependent on surrounding terrain and prevailing meteorological conditions.

Limited studies were conducted to investigate plume behavior and develop a basis for predicting the ground-level impact of stack emissions on air quality (Spangler et al., 1973; Spangler et al., 1974). These studies included a field tracer plume-simulation study using 20 oil fog releases in November 1973, and a coordinated smoke and fluorescent-particle (FP) tracer study in May 1974 using 10 releases.

The following conclusions were reached:

1. The general topography of the Kaiparowits area is of irregular terrain, so that "very stable" atmospheric conditions such as frequently occur elsewhere in the Southwest are less common here. Airflow over this irregular

FIGURE III-5

Estimated Full-load[a] Emissions and Emission Rates Resulting from Regulation Compliance and Proposed Control

Pollutants	NSPS[b] Emission Limitations ($lbs/10^6$ Btu)	Emission Rates (tons/hour)	Proposed Emission Control (percent)	Proposed Control Emission Rate ($lbs/10^6$ Btu)		Proposed Control Emission Rate (tons/hour)	
				Avg. Coal	Worst Coal	Avg. Coal	Worst Coal
Sulfur dioxide	1.20	17.8	90.0	0.08	0.15	1.15	2.17
Particulate matter	0.10	[c]1.5	99.5	0.03	0.04	0.43	0.58
Nitrogen oxides	0.70	10.4	32.5	0.70	0.70	10.40	10.40

a Full load 29,680 Btu/hour

b NSPS: Federal New Source Performance Standards

c The water contract with the Department of the Interior requires a design efficiency of 99.5 percent removal of particulate matter (0.43 and 0.58 tons/hour) with monthly averages not less than 97 percent (2.6 and 3.5 tons/hour) and a 24-hour average not less than 96 percent (3.5 and 4.7 tons/hour).

terrain causes turbulence, resulting in more rapid plume dispersion than would be predicted over flat terrain. For air-mass stability conditions classified as neutral (Pasquill D) over flat terrain, observed dispersion characteristics at Fourmile Bench varied between those expected under "slightly unstable" (Pasquill C) and those expected under "very unstable" (Pasquill A) atmospheric conditions. With a "slightly stable" air mass (Pasquill E), observed dispersion characteristics were nearer those expected under "slightly unstable" (Pasquill C) conditions. A discussion of stability categories and related plume dispersion characteristics is presented in Chapter II, page II-62, and Appendix II-2.

2. In general, the Fourmile Bench field data did not reveal a situation that would lead to a significant impact of power plant emissions upon surrounding terrain. With elevated stacks and virtually unrestricted wind flow at the site, good plume transport and dispersion from Fourmile Bench could be expected.

3. On three oil-fog release occasions (FMB-1, FMB-2, FMB-4) in the November 1973 field study at Fourmile Bench, stable plumes were transported northeast toward Straight Cliffs, clearing elevated terrain. The release altitude of FMB-1 was 8,700 feet (2,600 feet above ground level); FMB-2 was released at 7,500 feet (1,400 feet AGL); and FMB-4 was released at 7,400 feet (1,300 feet AGL). Stability conditions were calculated from temperature soundings taken at the release point before and after release. The FMB-1 release was 30 minutes in length with a stable air mass indicated up to 400 feet below release altitude and near neutral conditions up through plume altitude. The wind was from the southwest at 8 meters per second. The smoke plume was a straight path. The only vertical motion evident was a slight rise as the plume moved over the higher terrain. The plume was still intact and visible more than 20 miles downwind 35 minutes after the end of the release. FMB-2 was released into an inversion layer with neutral stability layers above and below. The plume had a stable but slightly wave-like appearance. The plume moved over the Kaiparowits Plateau, suddenly became more

wave-like and then mixed rapidly until it was no longer visible. FMB-4 release was made with a low level inversion below release altitude, but near neutral air-mass stability at plume altitude. The plume moved in a straight line toward the northeast with little vertical movement. The plume followed the terrain up and over the Kaiparowits Plateau, then descended into the valley north of the plateau where it rapidly dispersed. Terrain in the immediate vicinity of the site is well below expected plume altitude and characteristically rugged in nature, leading to enhanced dispersion.

Meteorological conditions during field studies in November and May included predominantly "neutral" or "slightly stable" conditions. Not all of the atmospheric conditions generally regarded as producing higher ground-level pollutant concentrations were experienced. Adequate assessment of the potential impact of the power station requires investigation of these atmospheric situations, using predictive modeling techniques.

Air quality impact predictions

"Very stable," "limited mixing" and "fumigation" situations, potentially responsible for higher ground-level concentrations, were not observed during the tracer studies at Fourmile Bench. At any particular site, the most critical meteorological condition leading to maximum pollution concentration might be any one of these, depending on local terrain, climate, stack parameters and other variables. At the Kaiparowits site, each of the potentially most-critical meteorological conditions was studied using a predictive model.

The tracer study results were used by Intera Environmental Consultants Ltd. (Intera, 1974) to compare the performance of four atmospheric dispersion models: the Intera (Intercomp) model, the NOAA model (Southwest Energy Study, Appendix E, 1972), the Valley model (C4M3D developed by EPA), and the TVA model.

A discussion of the concentration calculations, and comparison with the tracer results, appears in Appendix III-3. Intera concluded that their model is a slightly more accurate predictor of ground level concentrations than NOAA, TVA, or C4M3D models.

An additional comparison study was made by Intera (Intera Environmental Consultants Ltd., 1975). They compared the Intera model, EPA C7M3D model, and the NOAA model using data from the Navajo plant SO_2 study, the Huntington power plant study, and the Garfield smelter study. The results of this comparison study are discussed in Appendix III-3.

The Intera (Intercomp) model was used to predict ground-level concentrations of particulates, sulfur dioxide and nitrogen oxides for the "very stable," "limited mixing" and "fumigation" meteorological conditions. A summary of the assumptions used is shown in Figure III-6.

Calculation of annual average ground-level concentrations assumed the use of average grade coal, sulfur content of 0.42 percent, and a station operating capacity of 75 percent. Calculation of short-term concentrations (3-hour and 24-hour averaging periods) assumed use of worst-grade coal (sulfur content of 0.75 percent) and a 100 percent station-load capacity factor.

Expected stack plume rise (a function of stack conditions, atmospheric stability and wind speed) was calculated using the Tennessee Valley Authority plume-rise equation (Carpenter et al., 1971).

Stable atmospheric conditions

Stable atmospheric conditions reduce both rise of the heated plume into the atmosphere and its vertical diffusion. On flat terrain, the plume diffuses slowly to ground level, and maximum concentrations occur at great distances downwind after substantial horizontal diffusion. On irregular terrain, where

FIGURE III-6

Summary of Input Parameters
Used in the Intera (Intercomp) Model

Parameters	Value	
Total generating capacity (MW)	3,000	
Number of units	4	
Size of each unit (MW)	750	
Plant elevation (ft MSL)	6,100	(1859 meters)
Stack height (ft)	600	(183 meters)
Ambient temperature (F)	51	(11° Celsius)
Flue gas flow rate per unit (cubic feet per minute)	2,400,000	(1133 cubic meters per second)
Stack exit velocity (ft/sec)	70	(21 meters per second)
Flue gas temperature (F)	180	(82° Celsius)
Inside stack exit diameter (ft)	27	(8 meters)
Particulate emissions		
Abatement efficiency (%)	99.5	
Mass emission rate (ton/h)		
Average-grade coal	0.42	(109 grams per second)
Worst-grade coal	0.58	(146 grams per second)
Sulfur dioxide emission		
Abatement efficiency (%)	90	
Mass emission rate (ton/h)		
Average-grade coal	1.15	(290 grams per second)
Worst-grade coal	2.17	(547 grams per second)
Nitrogen oxides emission rate		
Mass emission rate (ton/h)	10.4	(2623 grams per second)

elevations exceed plume release height, there is a potential for greater ground-level concentrations, resulting from the effect of the terrain on the plume. Elevations considerably higher than the Fourmile Bench site occur to the north and east, and therefore an investigation of stable-plume dispersion was conducted. Based on available site climatology, Category E stability was selected and assumptions of wind from the south (175°) at 3 meters per second (7 mi/h) and a plume rise to 2,317 meters (7,600 feet MSL) were used. The results appear in Figure III-7. The highest 1-hour concentrations were calculated to be 47 $\mu g/m^3$ at Right Hand Collet.

Predicted ground-level concentrations, during nonfumigation conditions such as the "stable" and "unstable" cases, are most representative of 1-hour averages. The Pasquill-Gifford stability classes were considered to have a 1-hour averaging time as an upper limit, and use of the Intera model, with diffusion coefficients equivalent to Pasquill-Gifford classes, would also result in 1-hour averages.

To compare these values with Air Quality Standards, longer time periods must be used. For the 3-hour time period under "nonfumigation" conditions, the TVA peak-to-mean conversion factor of 0.75 (Montgomery et al., 1971) was used in calculating equivalent concentrations. One-hour and three-hour calculations appear in Figure III-7. The calculated maximum 3-hour concentration for SO_2 of 35 micrograms per cubic meter ($\mu g/m^3$) for the "stable" condition occurred approximately 12.5 km (8 miles) directly north of the site at an elevation of 2,150 meters (7,100 feet). Concentrations along the Kaiparowits Plateau northeast of the site did not exceed 27 $\mu g/m^3$. These concentrations are below the "significant deterioration" maximum (700 $\mu g/m^3$) for a Class II area.

At present there is no widely accepted mathematical model for calculation of ground-level concentrations of contaminants in stable air masses near

FIGURE III-7

Predictions of Sulfur Dioxide Ground-Level Concentrations Under Varying Meteorological Conditions at Fourmile Bench Using Intercomp, C7M3D, and NOAA Models

Model	Meteorological Condition	Calculated Concentration[a] (μg/m^3)	Calculated Equivalent 3-hr. Concentration (μg/m^3)	Location	Elevation (m)	Distance (km)	Wind Speed (m/sec)	Wind Direction (deg)
Intercomp	Stable	24	17	Kaiparowits Plateau south end	2310	40	3	280
	Stability Class E	36	27	Kaiparowits Plateau north end	2200	30	3	254
	Plume height 2317 meters	47	35	Right Hand Collet	2150	20	3	175
C7M3d	Stable	85	52	Kaiparowits Plateau south end	2200	37	3	280
	Stability Class E	40	25	Kaiparowits Plateau south end	2310	48	3	280
	Plume height 1996 meters	117	72	Kaiparowits Plateau north end	2200	30	3	254
		113	70	Kaiparowits Plateau north end	2133	26	3	254
		65	40	Right Hand Collet	2377	31	3	175
		170	105	Right Hand Collet	2150	20	3	175
		138	85	Canaan Peak	2200	26	3	175
	Plume height 2020 meters	117	72	Kaiparowits Plateau south end	2200	37	2	280
		65	40	Kaiparowits Plateau south end	2310	48	2	280
		158	97	Kaiparowits Plateau north end	2200	30	2	254
		146	90	Kaiparowits Plateau north end	2133	26	2	254
		101	62	Right Hand Collet	2377	31	2	175
		231	142	Right Hand Collet	2150	20	2	175
		190	117	Canaan Peak	2200	26	2	175
NOAA	Stable							
	Stability Class E	271	203	Kaiparowits Plateau south end	2310	25	2	280
	Plume height 2317 meters							
	Stability Class E	347	252	Right Hand Collet	2336	21	2	175
	Plume height 2283 meters							
Intercomp	Unstable	67	50	Fourmile Bench		2.10	5	090
	Stability Class D							
	Plume height 2418 meters							
Intercomp	Limited Mixing	139	105	Fourmile Bench		2.10	5	090
	Stability Class							
	B-Mixed layer							
	E-Inversion layer							
	Plume height 2418 meters							
NOAA	Limited Mixing	116	87	Fourmile Bench		1.5		
	Stability Class							
	B-Mixed layer							
Intercomp	Inversion Breakup							
	Stability Class							
	B-Mixed layer							
	F-Inversion	263	181	Fourmile Bench		2.10	3	090
	E-Inversion	272		Fourmile Bench		2.10	3	090
	Plume height 2317 meters							

[a]Source Strength 547 gallons per second.

plume height terrain. The NOAA model (Southwest Energy Study, Appendix E, 1972) assumes that under stable atmospheric condition the plume centerline flows horizontally until it encounters terrain at plume elevation and then impinges directly on the terrain. Predictions of ground-level concentrations in rough terrain using the NOAA model represent more conservative assumptions in terms of estimating ground-level concentrations under stable conditions and very likely define the upper bounds of expected concentrations.

Based on the recently completed Navajo power plant sulfur dioxide study (North American Rockwell, 1975) using NOAA E stability, with winds at plume height during the time of measured maximum concentrations, it can be shown that the NOAA model predictions were within factors of only about 1.4, 1.8, and 3.0 for the three highest measured cases (October 16, November 24, and December 2, 1974). Removal of the reflection factor for the NOAA model would result in an agreement factor of approximately 0.7, 0.9, and 1.5, respectively.

Williams (1975) suggests that the NOAA E stability, at 2 meters per second and no reflection, provides an appropriate representation of the stable case. Using the input parameters shown in Figure III-7 for the stable case, the calculated 3-hour maximum would be 203 $\mu g/m^3$. Calculated concentrations at 7,400 feet at a distance of 21 kilometers near Right Hand Collet, north-northeast of the site would be 252 $\mu g/m^3$ for the 3-hour concentration (Figure III-7).

The EPA plume diffusion model C7M3D calculates the highest 3-hour concentration for the stable case to be 120 $\mu g/m^3$ for 3 meters per second winds or 165 $\mu g/m^3$ for 2 meters per second winds. These values fall in between the Intercomp calculations and the NOAA calculations.

Unstable atmospheric conditions

"Unstable" atmospheric conditions are similar to those observed during the tracer studies. A looping plume develops in which puffs may be taken up or

down by convective cells in the air mass. The maximum 3-hour-equivalent SO_2 concentration predicted by the model was 50 $\mu g/m^3$ or 0.02 parts per million (ppm) (Figure III-7). During tracer tests, the FP tracer impact, when scaled to equivalent hour or 3-hour SO_2 concentrations, was determined to be less than 0.02 ppm (Spangler et al., 1974).

Limited mixing

In "limited mixing" conditions, an elevated inversion is assumed, with the layer below being neutral or well-mixed while the atmosphere above the inversion base is stable. The inversion base generally forms a lid that reduces vertical dispersion of emissions, trapping them within a mixing volume determined by the height of the inversion base and the surrounding terrain. Calculations for the "limited mixing" case used wind directions chosen to keep maximum concentrations on the source bench, which is the highest terrain involved. An average wind speed of 5 meters per second (11 mi/h) was assumed, with a mixing height of 500 meters (1,600 feet). Maximum ground-level concentration under these conditions was 105 $\mu g/m^3$ for the 3-hour averaging period (Figure III-7), assuming 90 percent SO_2 control. This concentration is within the Class II area limitation, but it is over 4 times higher than the usual maximum 1-hour background SO_2 concentration (Walther et al., 1974).

Calculations by Williams (1975) for the limited mixing case and B stability gave 116 $\mu g/m^3$ for the short term concentration and approximately 87 $\mu g/m^3$ for the 3-hour value. This compares well with the value of 105 $\mu g/m^3$ calculated by the Intercomp model.

Inversion breakup

In this atmospheric process the plume, initially embedded in a stable layer of air, is rapidly mixed to the ground by convective activity beginning at ground level shortly after sunrise. Highest ground-level concentrations during

this fumigation process are reached when the convective activity extends to just above the stable plume height. Of the four dispersion conditions tested using the Intercomp model, the inversion-breakup condition resulted in the highest 1-hour ground-level concentration. The concentration was 263 $\mu g/m^3$ approximately 1.2 miles (2 km) downwind. Because the inversion-breakup condition does not generally persist longer than an hour, the 3-hour concentration was calculated by assuming inversion breakup during the first hour, and limited mixing for the remaining 2 hours, with the wind constant for the entire period. The resulting 3-hour SO_2 concentration was 181 $\mu g/m^3$ (Figure III-7).

Additional assumptions were required to estimate 24-hour and annual concentrations. For the Intercomp calculations, 24-hour maximum ground-level concentrations were calculated by estimating length of time maximum conditions are likely to persist and then making a judgement as to conditions likely during the rest of the day. In this calculation an hour-long inversion-breakup condition, 6 hours of limited mixing, and stable conditions the remainder of the time were assumed. Stack plumes were assumed to meander over a 22.5 degree wind sector. Under these conditions, a maximum 24-hour concentration of 45 $\mu g/m^3$ would occur 1.3 miles (2,100 meters) downwind (Figure III-8). For annual average concentrations, wind-direction frequencies at plume altitude and the frequency of various meteorological conditions at Fourmile Bench were considered. It was assumed that stable conditions occurred 50 percent of the time and neutral conditions, with a mixing height of 3,300 feet (1,000 meters), the remainder. Concentration calculations were made downwind of the station, considering the most frequent wind direction (270°), and the wind direction where maximum short-term concentrations were found (90°). The predicted concentration in both cases was 2 $\mu g/m^3$, assuming 90 percent SO_2 emission control.

Using a combination of neutral and stable meteorological conditions to estimate average annual concentrations ignores fumigation and unstable cases.

FIGURE III-8

Comparison of Air Quality Standards With Calculated Ground-Level Concentrations (Fourmile Bench)

Emission	Maximum Calculated Ground-Level Concentration					Natural Background Concentration	Most Restrictive Air Quality Standard[a]	Percent of Most Restrictive Standard			Ambient Air Quality Standard		Percent of Ambient Air Quality Standard		
	Intercomp[b]		NOAA[c]		C7M3D[d]										
	(μg/m³)	(ppm)	(μg/m³)	(ppm)	(μg/m³)	(μg/m³)	(μg/m³)	Inter-comp	NOAA	C7M3D	(μg/m³)	(ppm)	Inter-comp	NOAA	C7M3D
Particulates															
Annual	1					30	10	3			60		2		
24-hour	12		16			Highly variable	30	40			100		12	16	
Sulfur Dioxide															
Annual	2	0.0008	3	-		Negligible	15	13			50	0.02	4		
24-hour	45	0.017	58	0.022	57	Negligible	100	45	58	57	365	0.10	12	16	16
3-hour	181	0.070	252	0.097	142	Negligible	700	26	36	20	1300	0.50	14	19	11
Nitrogen Dioxide															
Annual	[e]12	0.007				Negligible	100	12			100	0.05	12		

[a]Based on an area designation of Class II under federal regulations for prevention of significant air quality deterioration.

[b]Maximum concentrations are expected at a downwind distance of 2,100 meters, fumigation case.

[c]Maximum concentrations are expected at a downwind distance of 21 kilometers, stable case.

[d]Maximum concentrations are expected at a downwind distance of 20 kilometers, stable case.

[e]Assumes all nitrogen oxides converted to nitrogen dioxide.

Since stable layers all the way through plume height are rarely found, it was assumed that incidents of fumigation would be infrequent. Unstable situations were assumed to be quite common, based on the tracer studies. Assuming low wind speeds a maximum of 7.3 percent of the time from south-southwest, and that one-third of each day is potentially unstable, the predicted annual values from these unstable conditions would be 1 $\mu g/m^3$.

Maximum calculated ground-level concentrations compared with the most restrictive applicable air quality standards are shown in Figure III-8. Values for particulates and nitrogen dioxide were calculated by relating respective source strengths to those of sulfur dioxide (Figure III-5), and assuming similar dispersion.

Data in Figure III-8 show that calculated concentrations, based on the Intercomp model considering the fumigation condition as the limiting case, and assuming 90 percent SO_2 control, 99.5 percent particulate control and 32.5 percent NO_2 control, are below national ambient air quality standards established to protect human health.

The NOAA model and the C7M3D model give higher concentrations for the stable case although the levels are not significantly higher than those of the fumigation case using the Intercomp model. The levels are still below the national ambient air quality standards.

Experience indicates that 99.5 percent particulate control can be obtained. Experience with SO_2 emission control is more limited but based on present studies and improving technology 90 percent efficiency seems feasible by 1980. However, there could be a difference between design efficiency and reliability, and operating efficiency and reliability. The Federal New Source Performance Standards (NSPS), Ambient Air Quality Standards, and Prevention of Significant Deterioration Regulations (PSDR) provide maximum limits to afford protection of air quality, health and welfare, and must be met. Based on projected coal

quality, emission rates, and predicted ground-level concentrations under worst case meteorological conditions using the Intercomp, NOAA, and C7M3D models, the proposed power plant would have the following emission control as a minimum:

a. 77.8 to 82.8 percent SO_2 control based on compliance with the 24-hour standard for a Class II area under the PSDR regulations and predicted ground-level SO_2 concentrations using the Intercomp or NOAA model.

b. 98.8 to 99.1 percent particulate control to meet the PSDR 24-hour limitation or 98.8 percent to meet the NSPS emission limitation of 0.10 $lb/10^6$ Btu.

c. The limitation on NO_2 emission would be the 0.70 $lb/10^6$ Btu heat input or approximately 32.5 percent boiler control.

The emission type, percent control required, and emission rates are summarized in Figure III-9.

The emission rates and resulting predicted ground-level concentrations under worst meteorological conditions and limited dispersion conditions are below both primary and secondary ambient air quality standards. These standards are established to protect human health and welfare. Maximum allowable pollution limitations are set at levels which are currently defined as necessary for the protection of human health and welfare, allowing an adequate margin of safety. No adverse impacts to humans, vegetation, soils, or animals are expected at the ground-level concentrations predicted. No adverse effect on human health from SO_2, NO_x and particulate emissions would be expected.

The Fourmile Bench site is within an approximate 30-mile radius of two National Park Service areas (Bryce Canyon National Park and Glen Canyon National Recreation Area) and within a 60-mile radius of several other national parks, national monuments and national forests. These areas have the potential for redesignation to Class I areas in which practically any change in air quality would be considered significant. There is the possibility that if any of these

FIGURE III-9

Calculated Percent Control of Emissions Required by NSPS and PSDR and Corresponding Emission Rate at 100 Percent Load, Worst Grade Coal and Most Limiting Meteorological Conditions

	Percent Control Required			Emission Rate Tons Per Hour		
Pollutant	NSPS	PSDR Class II NOAA Model	Intercomp	NSPS	NOAA	Intercomp
Particulate						
24-hour standard	98.8	99.1	98.8	1.40	1.05	1.40
Sulfur dioxide						
24-hour standard	17.8	82.8	77.8	17.76	3.72	4.79
3-hour standard	17.8	72.2	61.3	17.76	6.00	8.36

NSPS: Federal New Source Performance Standards
PSDR: Federal Prevention of Significant Deterioration Regulations

areas receives a Class I designation, the effluent plume from Kaiparowits could exceed Class I air quality limitations. Under stable conditions, the predicted ground-level concentrations at distances over 40 km (25 miles) would be 17 to 40 $\mu g/m^3$ for the 3-hour concentration and 13 to 16 $\mu g/m^3$ for the 24-hour concentration, depending upon the assumptions made and the models used. Either of these predicted concentrations would exceed the very small allowance for SO_2 increase in a Class I area (25 $\mu g/m^3$ for 3-hour concentration and 5 $\mu g/m^3$ for the 24-hour concentration). Williams (1975) calculated the 24-hour concentration for Bryce Canyon National Park to be 23 $\mu g/m^3$ for a plume traveling from Fourmile Bench under stable conditions. These predictions are only preliminary. Careful consideration of meteorological conditions and their persistence and corresponding plume transport would have to be made if reclassification of the areas occurred. Meteorological data with which to study the situation are very limited. These preliminary calculations do, however, point out the probability of violation of locations such as Glen Canyon Recreational Area and Bryce Canyon if they were designated as Class I areas. The National Park Service (1976) feels that the operation of the Kaiparowits plant would result in air quality impacts that are adverse to the legislative purpose of Glen Canyon National Recreation Area and Bryce Canyon National Park. The relevant extracts from the appropriate legislation are as follows:

> Glen Canyon NRA was established "...in order...to preserve scenic...features contributing to public enjoyment of the area..." (86 Stat. 1311)
>
> Bryce Canyon NP was initially established as Utah National Park to be managed "...subject to the provisions of the Act of August 25, 1916, entitled "An Act to establish a National Park Service, and for other purposes."..." (43 Stat. 593)
>
> The Act of August 25, 1916 states that parks under the administration of the National Park Service shall be managed "...by such means and measures as conform to the fundamental purpose of the said parks, monuments, and reservations, which purpose is to conserve the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of the same in such a manner and by such means as will leave them unimpaired for the enjoyment of future generations." (39 Stat. 535).

The National Park Service in cooperation with EPA is presently undertaking a study to determine whether or not to recommend reclassification to Class I for areas around Bryce and Capitol Reef national parks and Glen Canyon National Recreational Area.

Stagnation episode

A period of limited dispersion with low mixing depths, low wind speeds, and no significant precipitation for 2 days or longer is considered a "stagnation episode." Such a condition is similar to the limited-mixing case previously described. The maximum ground-level concentration calculated for the 3-hour limited-mixing case of 87 to 105 $\mu g/m^3$ assuming 90 percent SO_2 control would not be expected to be exceeded during an extended period, because of mixing and dilution activities even under stagnation conditions.

Beyond about 15 miles from the proposed site, the terrain rises to approximately 7,500 feet. Predicted stack plume rise, under most meteorological conditions, including limited mixing, is calculated to be 7,500 feet or greater. On this basis, it would be expected that even under conditions of relatively low mixing depths in the range of 3,000 feet, emissions from the Fourmile Bench site would be dispersed over a somewhat greater area than the Navajo Basin, rather than accumulating in a more restricted geographical area.

Ozone

Studies conducted near eastern power plants (Davis et al., 1974) have shown that initially power plant plumes consume ozone resulting in an ozone depleted atmosphere close to the power plant. At distances of 40 km (25 miles) or more downwind, the plume can become a net producer of ozone. In the East the studies suggest that ozone standards may be exceeded regularly during the summer by operation of large (1,100 MW) power plants. A recent study by Meteorology

Research Inc. (1975) for EPA, measured plumes from several plants in the St. Louis area. In one case ozone concentrations exceeding the Federal Ambient Air Quality Standard (0.08 ppm) were found within the urban plume 50 km or more downwind on each of 5 days during which sampling was conducted. In another case, plumes from three other plants were measured 30 and 55 km downwind and none of the plumes showed any ozone enhancement of the type described by Davis et al. (1974). All of the plumes were characterized by ozone deficits at all sampling distances. Preliminary studies by Williams (1975) of the Navajo plant plume have confirmed the initial depletion of ozone but ozone enhancement has not been measured.

Ozone production is dependent upon the presence of other factors, such as reactive hydrocarbons which may or may not exist in sufficient quantities in the Kaiparowits atmospheric environment. Williams (1975) suggests that hydrocarbons from natural coal fires, power plant upset and start-up conditions, or from terpenes produced by vegetation may be sufficient to produce similar ozone enhancement conditions in the Kaiparowits area. The potential of ozone production from coal-fired power plants is not yet well defined. As pointed out by Spence (1975), more studies of ozone production are needed before the effects of this pollutant can be evaluated.

Trace elements

As a class, trace-element contaminants, principally heavy metals, have been a particular concern among identified environmental pollutants (Flinn and Reimers, 1974). Beryllium and mercury have been officially declared hazardous air pollutants with national emission standards established (EPA, 1973). These standards apply only to specific processing and manufacturing facilities, and do not include coal-fired power plants. Cadmium is on a proposed list of hazardous air pollutants and others such as selenium, vanadium and lead are under study.

The 1972 Southwest Energy Study investigated the quantities of trace elements to be released from plants at various phases of power development (SWES, 1972, Appendix J). No estimates were made, however, of the relative amount of each trace element emitted to the atmosphere, removed with bottom ash, or captured by control equipment. Little information existed at that time on the behavior of trace elements after coal combustion, but subsequent studies have provided more information on the fate of trace elements after coal combustion. These studies can be used to make estimates of concentrations of elements in ash and flue gas, recognizing that uncertainties still remain.

The quantities of trace elements calculated to be available from Kaiparowits coal are shown in Chapter I. Trace-element quantities shown in Figure III-10 (taken from Appendix III-5 and modified slightly based on recent studies by Radian, 1975) are for elements identified as potentially deleterious to human health and others monitored with air samplers at Page, Arizona. The calculated concentrations in Figure III-10 necessarily include a number of assumptions:

1. Concentrations of trace elements in washed coal to be burned would be approximately the same as those in the analyzed coal sample.

2. 34,600 tons of washed coal would be burned per day.

3. Coal would average 9.0 percent ash.

4. 3,114 tons of ash would be produced per day, of which 311 tons would be bottom ash and 2,803 tons would be fly ash.

5. Distribution of elements in bottom and fly ash is predictable on the basis of studies by Klein et al., 1975; Kaakinen et al., 1975; Zoller et al., 1975; Woodward-Envicon Inc., 1974; Radian, 1975; and Southwest Energy Study, 1972. Fractional release as gases and vapors was predicted by Williams and Walther, 1974; Southwest Energy Study, 1972; and Radian, 1975.

6. 99.0 to 99.5 percent of the fly ash would be removed from the flue-gas stream.

7. Estimate of trace element removal by the SO_2 scrubbing system is based on the recently completed study of Radian (1975) for EPA, comparing elemental removal with a wet venturi particulate scrubber and hot side electrostatic precipitator.

8. Flue-gas flow rate for all four units would be 9.6 x 10^6 cubic feet per minute.

9. Use of average grade coal and a 75 percent load factor for calculation of long-term accumulation.

By relating the stack-source strength of the particular element to that of SO_2, and assuming dispersal in a similar manner, ground-level concentrations were approximated using the dispersion modeling data previously discussed. The results are summarized in Figure III-11.

Calculated values were compared with information on background levels of trace elements at Page, Arizona. Calculated levels, assuming worst-case short-term emission rates and maximum ground-level concentrations, are near or below measured background levels at Page.

The predicted level of mercury emission of 4 pounds or 1.816 kg a day compares with an EPA emission limitation of 2.300 kg per day for mercury at processing facilities (no limitation exists for fossil-fuel plants). The highest predicted ambient air concentration of 0.01 $\mu g/m^3$ is a factor of 100 below the EPA limitation. EPA limitations for beryllium are set at 10 grams a day for most regulated beryllium sources. This level was determined by dispersion estimates as that which would forestall 30-day average ambient concentrations exceeding 0.01 $\mu g/m^3$. Predicted emission from the proposed Kaiparowits plant of 0.1 pound or 45 grams per day (Figure III-10) would result in a maximum predicted short-term ambient air level of 0.0003 $\mu g/m^3$ (Figure III-11) with a calculated 24-hour

FIGURE III-10

Predicted Release of Selected Trace Elements
From Stacks of Proposed Power Plant

Element	[a]Element Availability After Coal Combustion (lb/day)	Fractionation After Coal Combustion (lb/day)		Location After Fractionation (lb/day)		
		Bottom Ash	Fly Ash	Precipitator Capture[b]	Scrubber Capture	Stack Emission
Titanium	18,400	1,840	16,560	16,480	Small	80.0
Barium	14,300	1,430	12,870	12,800	Small	70.0
Boron	8,576	0	8,576	8,533	13	30.0
Fluorine	5,800	0	5,800	2,900	1457	1457.0 (50% of fractional releases gas)
Manganese	844	84	760	756	Small	4.0
Chromium	311	0	311	309	Small	2.0
Nickel	272	0	272	271	Small	1.0
Lead	233	0	233	232	Small	1.0
Selenium	204	0	153	152	15	37 (25% fractional releases gas)
Arsenic	58	0	44	43.8	Small	14.0 (25% fractional releases gas)
Cadmium	58	0	58	57.7	Small	0.3
Beryllium	25	3	22	21.9	Small	0.1
Mercury	4	0	0	0	?	4.0
Zinc	398	0	398	396	Small	2.0
Copper	498	0	498	496	Small	2.0
Cobalt	12	0	12	11.9	Small	0.1
Vanadium	550	0	550	547	Small	3.0

Note: Calculations based on power plant operating at 3000 megawatt, 100 percent load, worst grade coal.

[a]Calculated average based on coal and ash analysis presented in Appendix III-5.

[b]Precipitator capture at 99.5 percent.

FIGURE III-11

Comparison of Measured Air Concentrations of Trace Elements and Calculated Ground-level Concentrations from Kaiparowits Plant Emissions

Element	Calculated Emission Concentration (μg/m³)	Maximum Calculated Ground Level Concentration (μg/m³) 3 Hour	24 Hour	Annual	Measured Concentration (μg/m³) 1969-1972[b]	1973[c]	1974[c]
Titanium	93	.22	.06	.002	0	NM	NM
Arsenic[a]	22	.05	.01	.0005	.002	<.001	NM
Mercury[a]	5	.01	.003	.00012	0	NM	NM
Manganese[a]	5	.01	.003	.00012	.01	.01	NM
Vanadium	4	.008	.002	.00009	0	NM	NM
Chromium[a]	2	.005	.001	.00006	0.004	<.001	NM
Copper	2.0	.005	.001	.00006	0.13	.06	.10
Zinc	2.0	.005	.001	.00006	0.90	.03	.05
Nickel[a]	1	.003	.0007	.00003	0.004	0	NM
Lead[a]	1	.003	.0007	.00003	0.08	.10	.20
Cadmium[a]	.3	.0008	.0002	.000009	0.001	NM	NM
Beryllium[a]	0.1	.0003	.00007	.000003	NM	NM	NM
Cobalt[a]	0.1	.0003	.00007	.000003	0.002	.003	NM

[a] Deleterious to health.

[b] Concentration of trace element measurements made from 1969 through 1972 at Page, Arizona. Arithmetic mean of annual arithmetic mean concentrations available from 1969 through 1972 (Walther et al., 1974).

[c] Data provided by Arizona Department of Health Services, 1975.

maximum concentration of 0.00007 $\mu g/m^3$, both of which are significantly less than the 0.01 $\mu g/m^3$ standard.

There are no established guidelines to compare other elements. Based on a comparison of measured background levels of trace elements at Page, and predicted ambient air concentrations using conservative assumptions, trace-element emissions are not expected to be of sufficient concentrations to cause ground-level concentrations that would result in an impact on human health.

Pathways by which many of the trace elements are distributed through an ecosystem are complex and, in many cases, not well defined. Studies of Lake Powell water and distribution of elements through the levels of the aquatic food chain have provided an example of mercury bioamplification which has resulted in the concentration of small input amounts into significant levels in upper members of the aquatic food chain. Mercury concentration in larger predatory fish in Lake Powell has approached or exceeded the current safe consumption standards (Food and Drug Administration guideline limitations of 0.5 ppm total mercury in flesh of fish) as discussed in Standiford et al., 1973, and Potter, et al., 1975. These concentrations are primarily from the movement of naturally occurring mercury into the lake system. The mercury contribution from the Kaiparowits plant to this lake system would depend upon the mercury concentration in the coal, the amount released from the plant, the deposition rate on the watershed and lake, and the rate of movement of watershed-deposited mercury into the lake. The predicted release rate of mercury from the generating station, averaged over a year, would be approximately 3 pounds a day, assuming the use of average grade coal with an average mercury concentration of 0.05 to 0.07 ppm and an annual generating station load factor of 75 percent. This prediction of the release of 3 pounds a day does not consider possible removal of some mercury by the wet lime SO_2 scrubbing system. The calculated concentration of mercury in the stack gases would be approximately 3.5 $\mu g/m^3$. A very rapid dilution in 500 to 1,000 volumes

of air could be expected. Diluting with 500 volumes of air would result in an atmospheric concentration of .009 $\mu g/m^3$. Background concentration of mercury in air 400 feet above the ground in the southwestern United States ranges from 0.003 to 0.009 $\mu g/m^3$ (USGS, 1970) with higher levels closer to the ground. Mercury entering the atmosphere can be deposited on the earth's surface by dry fallout but most of it, both gaseous and particulate, is deposited by rainfall (USGS, 1970). The rate at which mercury emitted from power plants is returned to the surface is not well documented. Ursenbach (1975) suggests that, based on the behavior of elemental mercury, only small amounts of vaporized mercury would be removed against the driving force of mercury evaporation. For lack of field data, Walther (1975) assumed two limiting cases of deposition on the lake or its drainage. The first considered that only one-tenth of the plume would deposit on the Lake Powell watershed and, in the second case, three-quarters would deposit. These fractions were estimates of the least and most deposition expected, considering the size of the watershed and location of the proposed sites. The resulting deposition would range from 110 to 800 pounds a year for the two cases. Mercury from power plant emissions could reasonably be expected to move into Lake Powell by mechanisms similar to natural mercury movement. Based on estimates of Standiford et al., (1973), between 15 and 60 percent of the deposited mercury would reach the lake, or 16 to 480 pounds a year. This amount represents from 1 to 27 percent of the estimated yearly mercury deposition into Lake Powell from natural sources. Standiford estimates that the contribution from the Navajo power plant would be approximately 140 pounds a year for a total contribution from the two plants of 156 to 620 pounds a year, or 9 to 35 percent of the annual natural mercury input. The potential impact of mercury deposition is discussed further in the wildlife section.

Fluorides are pollutants with considerable potential for producing ecological damage because of the ability of vegetation to accumulate fluorides

from low ambient air concentrations. Little information is available on release rates of fluorides from coal-fired power plants. It is expected that at the Kaiparowits plant the particulate removal system would remove the majority of particulate fluorides and the SO_2 scrubbing system would remove major quantities of the gaseous fluorides. Emission of fluorides would be approximately 1,000 pounds a day, assuming the use of average grade coal, a 75 percent load factor, 50 percent fractional release of the fluorides as a gas and 50 percent removal of gaseous flourides by the wet-lime SO_2 scrubbing system. The assumption of 50 percent scrubber removal is undoubtedly conservative, considering the efficiency of water towers in fluoride removal at aluminum, phosphate, and steel plants, and the fact that lime is an effective capture agent for fluoride. The 50 percent fractional release may also be conservative considering the Radian studies (1975) which showed large quantities of fluoride collected in the particulate control system.

Fluoride is a cumulative toxicant and injury to vegetation usually results from a fluoride buildup in the leaves over a relatively long period (e.g., weeks or months) in contrast to the short-time exposure that normally causes injury with most atmospheric phytotoxicants (Hill, 1969). Threshold levels of fluoride injury to sensitive plant species identified thus far appear to be approximately 0.1 to 1 part per billion (ppb) over a period of several months. Calculated long-term ground-level concentrations of fluoride released from the Kaiparowits power plant would be approximately 0.024 $\mu g/m^3$ or 0.03 ppb, assuming 25 percent of the fluoride would be released as hydrogen fluoride. In the absence of SO_2 scrubbing, the calculated concentration would approximately double to 0.048 $\mu g/m^3$ or 0.06 ppb. These levels were estimated using conservative assumptions and are below the apparent lower threshold limit of injury to plants. Although no vegetation or animal injury would be expected at the levels predicted,

monitoring of fluoride movement would help define any environmental impacts from low-level fluoride emissions.

Radioactive nuclides

Power plant emissions would contain a small amount of radium and thorium, and their decay products, associated primarily with coal ash (Eisenbud and Petrow, 1964). Analysis of the coal that would be used at Kaiparowits shows the presence of 0.17 picocuries per gram (pCi/g) thorium-232, 0.18 pCi/g radium-228, 0.29 pCi/g thorium-230 and 0.13 pCi/g radium-226 for a total activity concentration of 0.77 pCi/g (Chapter II, page 50). Calculated emission concentration from combustion of this coal is approximately 0.26 picocuries per cubic meter at the stack exit. These calculations are shown in Appendix III-6.

Although no emission standards for coal-fired power plants have been promulgated for radionuclides, maximum permissible concentrations in air were established in the Atomic Energy Commission's Standards for Protection Against Radiation (1973), and can be used for comparison purposes.

Maximum permissible concentrations (MPC) of radionuclides in air have been set by the AEC (10 CFR Part 20) as well as by the U.S. Department of Commerce, National Bureau of Standards (Handbook 69). Occupational MPC is divided by 10 to obtain nonoccupational MPC, which in turn is divided by 3 to get the general public exposure MPC. For purposes of this comparison, the lowest MPC (insoluble) will be used (Table 2, Appendix, AEC 10 CFR Part 20).

Radionuclides	pCi/m^3	General Public Exposure pCi/m^3
Ra-226	2	0.067
Ra-228	1	0.033
Th-232	1	0.033
Th-230	0.3	0.01

The calculation of effective concentrations of known mixtures of radionuclides is accomplished by the following formula:

$$\Sigma_i \left[\frac{\text{calculated concentration}_i}{\text{MPC}_i}\right] = <1$$

Using this relationship, and applying the computed activity levels of the stack gases for each radionuclide at the stack exit:

$$\begin{array}{llllllll}
\text{Nuclide:} & \text{Ra-226} & + & \text{Ra-228} & + & \text{Th-230} & + & \text{Th-232} \\
\text{Ratio:} & \frac{0.047}{0.067} & + & \frac{0.065}{0.033} & + & \frac{0.072}{0.010} & + & \frac{0.061}{0.033} \\
\text{Sum:} & 0.70 & + & 1.97 & + & 7.2 & + & 1.85 = 11.72
\end{array}$$

As the gas is emitted from the stack, it would exceed the MPC in air for the general population. A dilution factor of at least 100 would be required to reduce the ground-level concentration to meet the MPC standard for the general population of less than 1.0. Based on dispersion calculations, flue gases could be diluted by factors in the range of 1,000 to 2,000 or even greater within short distances from the stack exit. Assuming a dilution factor of 1,000:

$$\frac{0.000047}{0.067} + \frac{0.000065}{0.033} + \frac{0.000072}{0.010} + \frac{0.000061}{0.033}$$

$$.0007 + .0020 + .0072 + .0018 = 0.01$$

With an assumed dilution rate of 1,000, the MPC level would be a factor of 100 below the allowable maximum.

Plume opacity

The opaqueness and appearance of a plume are affected by many factors including particulate mass and size distribution, particle shape and physical structure, refractive index, path length of light and angle of incidence, moisture

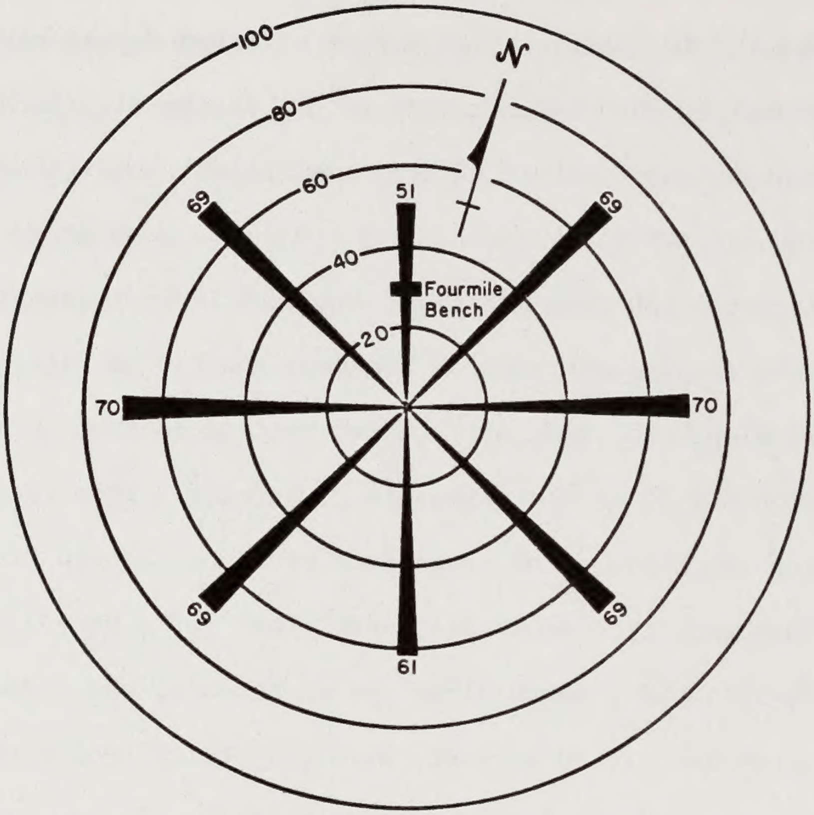
content of the effluent, weather conditions and plant-process changes. Federal and state regulations limit the opacity of emissions to 20 percent (as measured by the Ringelmann chart) for new installations. Radian Corporation conducted a study (1974) to predict plume opacity of the proposed Kaiparowits plant from various observer positions and in various light-incidence and atmospheric conditions, using a computer model evaluated during an experimental program at Four Corners generating station. For the design and operating conditions projected for the Kaiparowits plant, including 99.5 percent removal of particulates, the maximum opacity predicted would be 11 percent which is below the 20 percent opacity limitation. Experience gained at the Huntington power plant has shown that with 99.5 percent removal of particulates, the plume is virtually invisible. At Navajo, where average removal efficiency has been approximately 99.1 percent, the plume has been frequently visible. The opacity of the Navajo plume during these periods has not been documented.

Visibility

Reduction of visibility was identified in the Southwest Energy Study as the most dramatic effect of air pollution from coal-fired power plants in the Southwest. Although no standards for visibility have been promulgated by federal agencies or by the State of Utah, release to the atmosphere of particles generated as solids, and particles from gas-to-particle conversions, have the potential of significant impact on visibility. To assess the probable impact of emissions from the Kaiparowits plant, a study was conducted for the participants by Bechtel Power Corporation (1974). A review was made of research on the effect of atmospheric aerosols (solid or liquid particles suspended in air) on visibility, and calculations were made, using modeling techniques, to predict the effect of the Kaiparowits plant on visibility. Details of the study are provided in Appendix III-4.

In the Kaiparowits region, sulfur dioxide emission is not expected to have a direct effect on visibility. Conversion of sulfur dioxide to particulates could have an impact. In addition, the degree of brown discoloration present would be proportional to the concentration of NO_2 in the air (Bechtel, 1974).

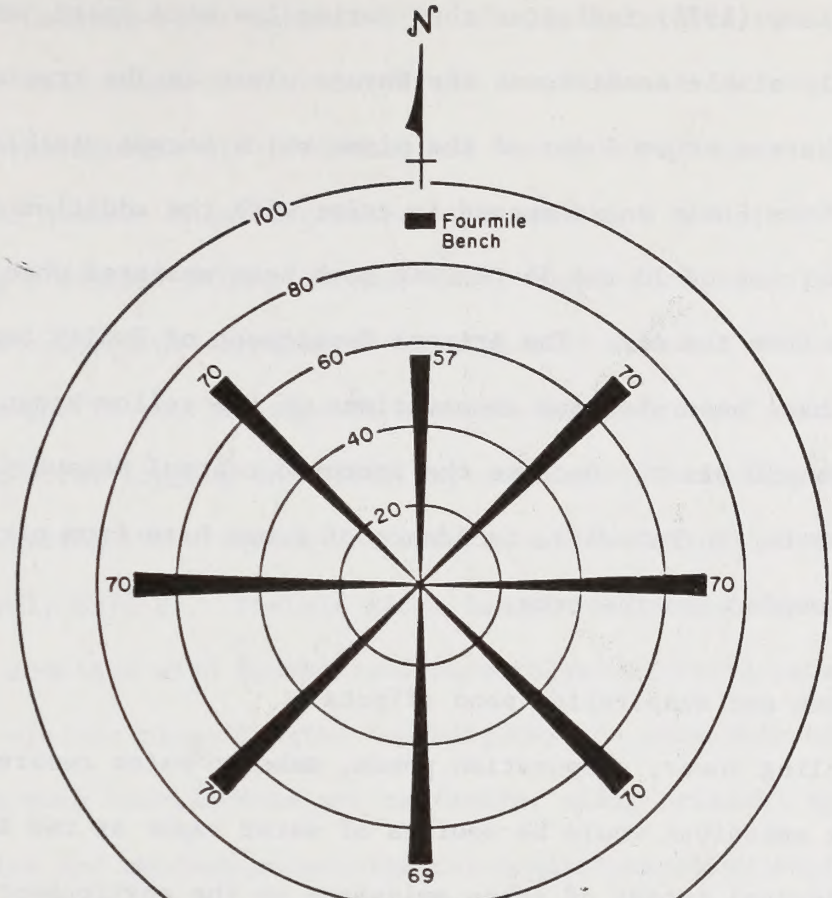
The Bechtel study assumed neutral atmospheric conditions and particulate emission rates assuming 99.5 percent control. It also considered visual ranges affected by an intact plume from locations which would influence relatively large numbers of people. The visual range of a person located at Page, Arizona, looking northward along the plume axis, would be reduced from 70 miles to 51 miles (Illustration III-1) or approximately 25 percent. From the same viewpoint, visibility looking south along the plume axis would be reduced from 70 miles to 61 miles, or 13 percent. The study also shows that for a person at Grand Canyon (Illustration III-2) looking north along the plume axis, the reduction in visual range would be approximately 20 percent, with visibility reductions along other lines of sight being insignificant. These visibility reduction predictions were based on meteorological conditions of humidity, wind, and neutral stability which were assumed to occur simultaneously about 5 percent of the time. More frequent visibility reduction could occur north and east of the site because prevailing winds would carry the plume in that direction. This is a more remote area and fewer people would be affected. Meteorological conditions more restrictive to dispersion, such as stable conditions, limited mixing or stagnation conditions, would occur less frequently but could further reduce visibility. Unstable atmospheric conditions and low wind speeds would also lead to a significant reduction in visibility, as indicated by Williams (1975). Lower emission control efficiency could also cause greater reduction in visibility. Actual observation of the plume from the Navajo generating station shows the plume to be visible from cross section. The effect of this plume on visibility has not yet been measured or



This illustration assumes that an observer is in the center of the rose (Page, Arizona) with the plume from a plant at Fourmile Bench overhead. Looking north toward Fourmile Bench, the visual range would be reduced from 69 miles to 51 miles. Looking south the visual range would be reduced from 69 miles to 61 miles.

ILLUSTRATION III-1

Visual Rose at Page, Arizona With Plant at Fourmile Bench
70 Mile Background Visual Range
(Frequency of Occurrence Less Than 5 Percent)



This illustration assumes that an observer is in the center of the rose (Grand Canyon) with the plume from a plant at Fourmile Bench overhead. Looking north toward Fourmile.Bench, the visual range would be reduced from 70 miles to 57 miles. Looking south the visual range would be reduced from 70 miles to 69 miles.

ILLUSTRATION III-2

Visual Rose at Grand Canyon With Plant at Fourmile Bench
70 Mile Background Visual Range
(Frequency of Occurrence Less Than 5 Percent)

documented. Williams (1975) indicates that during low wind speed, and under neutral to slightly stable conditions, the Navajo plume can be tracked visually because of the apparent brown color of the plume which became visible during the operation of the first unit and deepened in color with the addition of the second unit. Opacities of 20 and 54 percent have been measured when viewing through the plume from the air. The Arizona Department of Health Services indicates that there have been numerous observations of the yellow-brown haze in the vicinity of the Navajo plant. Because the proposed control measures for nitrogen oxides are similar for Kaiparowits, incidence of brown haze from nitrogen dioxide could become commonplace in the area.

Cooling tower plume and evaporation pond effects

The cooling tower, evaporation ponds, make-up water reservoir, and power plant stack emissions would be sources of water vapor at the Kaiparowits project. The principal impact of these emissions on the environment would be aesthetic, due to formation of water vapor plumes. But ground-level effects from salts in the mechanically entrained water droplets (distinct from recondensed water vapor), ground fogging, icing, reactions with sulfur dioxide emitted from the stacks, and the possibility of inadvertent weather modification must also be considered.

The main source of visible water vapor plumes would be the mechanical-draft cooling towers. Plumes from the power plant stacks would be visible at times during cold winter conditions. Since stack gases are reheated above the dew-point temperature, the length and frequency of these plumes would be less than those from the cooling towers.

Formation of a white, visible plume of condensing water vapor from the cooling towers depends on temperature and humidity of cooling tower exhaust and

ambient air. Cooling-tower exhaust air, usually saturated with water at a temperature greater than ambient, is transported downwind and diffused by air turbulence. As a result, the exhaust air cools and may become supersaturated if the ambient air is cold or humid. When supersaturation occurs, a small cloud of fog droplets form, causing a visible plume. Ground-level fogging or icing can occur during cold or humid conditions accompanied by high wind speeds. Under these conditions, plumes are caught in the lee-side of the towers and brought down to the ground.

Potential fogging and plume impacts from the cooling towers were evaluated by calculating the frequency of occurrence of visible plumes from the cooling towers (Bechtel, 1974 b). Visible plume length and height were calculated and results were combined with synthesized meteorological field data to provide frequency estimates of visible plume lengths and heights, and ground-level fogging and icing. While such calculations are tentative, using critical assumptions of plume condition and ambient meteorological conditions, they do form a basis for prediction.

Calculations of plume heights and lengths were based on equations presented in Hanna and Perry (1973). Calculations suggest that much of the time tower plumes would be short or invisible, with little effect on plant operation or the environment. During cold, humid conditions a visible plume may rise to nearly 3,000 feet and may also extend as far as 2 miles downwind. A visible plume would be expected to occur about 97 percent of the time at Fourmile Bench, but about half of the time it would evaporate before reaching a 180-foot length. Tower-plume lengths in excess of 1,000 feet would occur about 10 percent of the time, and lengths in excess of a mile about 0.3 percent of the time.

Ground fogging 1,000 feet downwind from the towers would be expected to occur about 8 percent of the time (30 days a year) and less than 0.2 percent of the time (1 day a year) at a downwind distance of a mile. Ground icing, due to

impingement of plume droplets on the surface at temperatures below freezing, would be expected to occur about 5 percent of the time (15 days a year) 1,000 feet downwind from the towers, and 0.06 percent of the time (1 day a year) at a downwind distance of 1 mile.

In addition to moisture from the cooling towers, localized minor increases in ground-level relative humidity would occur at the evaporation ponds and the make-up water reservoir.

The conclusions of the meteorological group for the Southwest Energy Study were that no detectable weather modification would result from the addition of moisture to the atmosphere from cooling towers. Water discharged by cooling towers would be only a small fraction of that released from lakes in the area. This discharge has shown no noticeable effect on climate.

Although the effects of the Kaiparowits cooling tower on weather are difficult to assess considering the prevailing low humidity in the area, it is not anticipated that anything but localized, short-term effects such as fog and wind could occur. The quantity of water evaporated from large lakes such as Lake Powell, Lake Mead, et cetera, is estimated to be about 0.7 million acre-feet a year with no measurable weather modification. Water that would be evaporated from the cooling towers is calculated to be 44 acre-feet a year, which is considerably below 0.7 million acre-feet a year.

Location of the Fourmile Bench site away from major roads and population areas would reduce the visual impact of plume fogging from the cooling towers.

During normal operation of the cooling towers, large droplets of cooling water are entrained in the updraft through the tower and eventually fall to the ground depositing dissolved solids (salts) concentrated in the water. Salt contained in this drift is important because of its possible effect on vegetation and ground water quality.

The amount of salt deposited is dependent on the amount of cooling water lost as drift, and the concentration of salt in the drift. A study to predict salt deposition from the proposed Kaiparowits plant has been made (MRI, 1974). For a preliminary design, a drift rate of 0.01 percent of circulating water flow was assumed. Southern California Edison estimates the drift rate would likely be in the 0.004 to 0.01 percent range, based on design specifications (Resource Data, 1974). According to Hanna (1974), typical measured values for drift at modern towers range from 0.001 to 0.01 percent of the circulating water flow.

Salt concentration in the cooling water depends upon the water source, Lake Powell in this case, and the number of cycles of that water through the cooling system. Lake Powell water, with about 800 ppm dissolved solids (Figure III-12), would be processed through lime-soda softening equipment, which would reduce total dissolved solids from 800 ppm to approximately 500 ppm (SCE, 1975).

Assuming 15 cycles of water containing 500 ppm dissolved solids, total dissolved solids would be about 7,500 ppm. This amounts to a total annual predicted salt dispersal of approximately 1,812 tons. The predicted deposition pattern is shown in the soils section. The potential environmental consequences of salt deposition on vegetation, soils, and water are discussed in subsequent sections of this chapter.

Coal mine emissions

Coal mining and processing produces dust. Coal dust, if uncontrolled, is a hazard to human health and safety. Accompanying secondary impacts -- productivity loss, welfare costs, loss of production from explosions and fire -- could be extensive.

In addition to dust, methane (CH_4) and carbon dioxide (CO_2) are frequently liberated in the mining process (Speltz and McCann, 1974).

FIGURE III-12

Average Maximum Concentrations of Individual Constituents in the Wahweap Bay Arm of Lake Powell

Constituent	(ppm)
Calcium (Ca)	99
Magnesium (Mg)	35
Sodium (Na)	110
Potassium (K)	5
Carbonate (CO_3)	[a]1.1
Bicarbonate (HCO_3)	[b]189
Chloride (Cl)	78
Sulfate (SO_4)	357
pH	([c]7.8)
Total solids	[d]815

[a] $NaCO_3$ in most analyses
[b] Total solids calculated include only .493 of the bicarbonate analysis.
[c] Range 7.2 to 8.4
[d] Determined by specific conductance, which includes all of the listed constituents, plus others.

Source: Analysis by Bureau of Reclamation of 61 observations from 1964 to 1970.

All methane and carbon dioxide from the mine would be vented to the outside, where they would be diluted to insignificant levels. Mine atmospheres of carbon monoxide (CO), hydrogen sulfide (H_2S), hydrogen (H_2) and various oxides of nitrogen (NO, NO_2, NO_3) produced from incomplete combustion of organic materials, blasting, and so on, would be transported outside by the ventilating system and quickly diluted. Total ventilating air predicted by the participants would be approximately 4 million cubic feet per minute if all mines were producing.

In the event of fire or explosion, most of the previously mentioned gases, but principally carbon dioxide and carbon monoxide, would be produced. Mine fires can vent large quantities of gas into the atmosphere, through mine entrances, ventilation systems or cracks and fissures in the overlying strata. It is possible that coal stockpiles near the mine at the rotary crusher, near the power plant, or the coal waste dump, could ignite by spontaneous combustion. Ignition could result in release of large quantities of smoke and noxious gases into the atmosphere.

In the winter, cool air circulated underground would warm and increase in moisture-carrying capacity. As the air is vented at the surface, it would mix with the cooler air and a plume of condensing moisture vapor could form around the exhaust ventilation shaft. This plume would not be expected to extend a significant distance or last for any great length of time.

Access road emissions

An evaluation of the impact of the proposed highway on air quality was made by the Utah Department of Transportation (Appendix III-8). Two conditions were considered: the roadway vicinity where concentrations of pollutants contribute noticeably to background pollution levels, and a large regional condition affected by traffic conditions caused by the proposed project. The primary

pollutants emitted by motor vehicles would be carbon monoxide (CO), hydrocarbons (HC), nitrogen oxides (NO_x) and particulates. Estimates of CO, HC, and NO_x were made for the large scale regional condition over the total length of the facility, and CO was estimated for the roadway vicinity.

The total pollutant burden was estimated over the proposed 70 miles of new roadway using the highest traffic projections in any given segment. The maximum CO burden would occur after opening of the road and would be approximately 22 tons a day for the entire length of the road. Because of the large air volume for dispersion, this level is not expected to result in significant impacts on air quality in the vicinity.

Carbon monoxide concentrations in the vicinity of the road were estimated at the town sites, assuming the road would go through the town, which would represent a worst-case condition. Under the worst meteorological conditions (a surface inversion condition, winds of 1 mile per second at an angle of 22.5 degrees to the roadway) and peak traffic (during shift change), the CO concentrations were estimated to be 1-5 ppm at 10 meters from the roadway. The CO levels would drop rapidly with increasing distances from the highway, and could be expected to be at background levels approximately 50 meters from the roadway. No significant impacts would be expected. The Utah Bureau of Air Quality has indicated that since the roads would be located outside of carbon monoxide strategy areas and since ambient concentrations are predicted to be well below the ambient standards, the proposal would be consistent with the Utah Implementation plan (Appendix III-8).

Access road noise

The impact of noise resulting from access highway traffic was also evaluated by the Utah Department of Transportation (Appendix III-8). The study

indicated, based on conservative assumptions, that with new residential developments placed at least 400 feet from main access roads, there would be minimal noise impacts. Federal Highway Administration near-peak noise limitations for a continuous span time would not be exceeded along existing highways used by trucks hauling limestone. The peak noise of individual passing trucks will probably average about 86 dBA at 50 feet and exceed 91 dBA during 5 percent of the individual passes (equivalent to a brief exposure to an operator of a power lawn mower or food blender on high speed). Communication at these brief instances would be nearly impossible. As far back as 200 feet from the roadway, the low frequency noise from heavy trucks would easily penetrate wood frame homes. It could be expected that baby's nap time, television listening, and other sound sensitive activities of the daytime and evening could be disturbed. The degree of annoyance would depend upon the amount of background noise and the nature of the working or living activity of the people at the time the noise is heard.

Other emissions

Other emissions from the proposed project could include fugitive soil particles, coal-handling dust, limestone dust from the kiln, fly ash from disposal handling, and engine exhaust emissions.

Fugitive dusts are solid particles of natural and industrial origin, usually formed in a disintegration process. These dusts can arise through particulate emission or from exposed soil surfaces at road and site construction and traffic on unsurfaced roads. Impacts are short term but do have aesthetic and health implications. The degree of impact depends on the amount of earth removed, removal schedule, soil moisture content, soil type, and influencing winds. With very dry, fine soil, fugitive emissions can be extensive. The presence of moisture, either in the soil or from wetting, would reduce fugitive emissions to negligible

levels. Uncontrolled fugitive dust emissions may create aesthetic impacts. Deposition of dust on nearby vegetation would be less significant. Air movement under most meteorological conditions should be sufficient to disperse unsuspended dust and reduce their impact. During less frequent limited-dispersal conditions, dust could remain suspended over small areas creating an aesthetic impact. With stronger winds, suspension of soil particles from exposed, unstable soil could create significant impacts on visibility.

After construction, road cuts, soil storage piles, and other disturbed soil surfaces could be a continuing source of dusts.

Coal dust can be created wherever coal is transported or stored. It is most likely to be generated in such locations as active and inactive storage, surge bins, storage silos, pulverization areas, refuse piles, sampling stations and transfer points. Transfer and storage operations can be restricted to minimal particulate emissions by use of standard control equipment such as fabric filters, water and nontoxic chemical sprays, fans and hoods. Final in-plant coal grinding, if uncontrolled, could cause high emission rates.

Ash from coal combustion is a potential source of dust emission. Bottom ash would be sluice discharged and, in a wet condition, would have minimal impact. Fly ash collected in the precipitator, pneumatically conveyed to a storage silo, then mixed with water upon loading, would produce a minimal level of dust emission.

Final disposal of the sludge-ash mixture is proposed to be at a landfill operation. An unprotected or unstabilized land fill could result in exposure of dust sources to wind erosion.

The lime kiln, proposed at the plant site, could be a large source of particulate emission from the handling, crushing, screening, and calcining of limestone, and combustion products from the kiln. Predicted particulate emission

from the limestone kiln would range between 3.9 and 7 tons a day depending upon operating conditions. The applicant anticipates the release of no more than 0.06 to 0.18 tons a day, representing 97.4 to 98.5 percent control. Bag house emission control which is proposed for use would be expected to operate at 99 percent control, further reducing emission. No adverse impact is expected.

Permissible dust concentrations for working areas are stipulated by Federal Occupational Safety and Health Administration (OSHA) regulations referred to in Chapter IV. These standards have been adopted by the State of Utah. The standards restrict total nuisance dusts to 15 $\mu g/m^3$. Coal dust concentrations (with less than 5 percent SiO_2) are restricted to less than 2.4 $\mu g/m^3$. The State of Utah requires submission of plans for proposed construction, to determine the adequacy of control equipment to meet these standards, before construction is approved.

In addition to OSHA standards for fugitive dusts, national ambient air quality standards for particulate matter would apply to all generating station areas, such as active and inactive coal storage locations.

Vehicles, the power plant, and mine machinery would be sources of particulate and gaseous emissions, including carbon monoxide, unburned or partially oxidized hydrocarbons, sulfur oxides and nitrogen oxides. Vehicular traffic would include trucks servicing the generating station and mine areas and hauling limestone, solid waste disposal vehicles, and employee vehicles used to travel to and from work. The impact from vehicular traffic has been discussed in the access road section. Emission from these sources would be expected to influence only the area close to the activity. Air movement can be expected to disperse pollutants into a large air volume.

Mining, transportation, and conversion of coal would require a large labor force. This labor force and their families would need storekeepers, teachers, doctors and other supporting services. The activities of these people would

degrade air quality in the locale in which they live. Population increase in the Kaiparowits impact area is projected to be approximately 14,000 by the tenth year of development. Pollution generated by this increase has been estimated (EPA, 1974) for particulates and sulfur dioxide.

Emission	ton/yr/person	By the Tenth Year (ton/yr)
Particulate	0.07	980
Sulfur dioxide	0.05	700

These emission additions to the ambient air include predicted contributions from transportation, solid waste disposal, residential and commercial fuel consumption, and miscellaneous sources.

These particulate emissions would equal 35 percent of the predicted annual particulate emissions from the generating station alone. Additional particulate emissions could be expected as the result of soil surface disturbance, both short term and long term, and from off-road recreational activities associated with the population increase. The surface disturbance could be severe and long term in the cold desert, depending upon soil types in the area, vegetative cover, susceptibility to disturbance and recovery potential. The SO_2 additions would be a much smaller percentage of the total generating station output (10 percent) but would add to the impact on air quality. These emissions represent low level releases with greater local attendant impact than if they were elevated releases from tall stacks such as those of the proposed power plant.

Transmission system impact area

Summary

The impact on air quality would not vary significantly between proposals. Impact would be caused by road building, tower site clearing, tower erection and stringing of lines. Pollutants would be particulates in these cases.

Heavy accumulations of vegetative material could have an adverse impact, especially in portions of the national forests in Arizona and California. If these products are accidentally burned, much carbon dioxide and other gases would be released to the atmosphere. This would result in reduced visibility but would not cause more than temporary discomfort for man.

Ozone production (Chapter II) would occur when the proposed power lines are energized. Amount of ozone produced is variable, depending on voltage in the lines, elevation, type and size of conductors, weather conditions and other factors. Under worst-possible test conditions, ozone from 765 kilovolt (kV) transmission lines was found not to create an adverse environmental impact (Scherer, 1973; Frydman, 1973). Although ozone production in nature, from lightning, or from a man-made arc welder can be occasionally detected by smell, no odor is detectable under major transmission lines.

Sensitive plants and animals would be subject to damage from concentrations of ozone, but circumstances required to reach such concentrations are not anticipated along these routes. Whereas global background concentrations of ozone between 0.015 and 0.030 parts per million (ppm) have been recorded, concentrations would have to reach 0.20 to 0.41 ppm to damage sensitive plants (Hill, 1961). Predicted concentrations of ozone from the proposed transmission lines are much below 0.05 ppm, a level detectable by smell.

Acceptable continuous exposure to ozone concentrations specified by the Occupational Safety and Health Act (OSHA) of 1972 is 0.1 ppm for any 8-hour period.

Noise and electrical interference are caused by the corona resulting when transmission lines are energized. Corona discharge produces not only ozone, but audible noise, radio and television interference, and electrostatic effects. Noise impact is strongest during conditions such as fog, heavy rain and snow. During fair weather, audible noise is near ambient sound levels: 30-50 decibels (db). See Figure III-13 for decibel relationships. In stormy weather, noise would increase 10-20 db, resulting at worst, in a noise level comparable to a typical business office, or to the level of average conversation. A more widespread impact along the transmission route would be experienced during construction, especially road building, tower construction and line pulling. These impacts would be most apparent near communities close to the proposed route.

Areas where citizens could expect temporary noise-related impacts during construction are as follows: the proposed new community; Page, Arizona; Searchlight, Nevada; Bull Head City, Arizona; Kingman, Arizona; Moapa, Nevada; Glendale, Nevada; North Palm Springs, California; Cabazon, California; and Ramoland, California. In addition, several small communities and unincorporated areas could be temporarily affected by noise pollution during the construction phase. These construction noises could result in discomfort for normal individuals, and perhaps interrupt the rest of ill persons.

A possible source of some disturbance and irritation would be helicopters used in various phases of tower construction. Helicopters traveling over the proposed route may cause sound waves over a fairly widespread area.

These same towns and communities would experience a slight residual impact from periodic aerial patrols every 180 days after construction.

Radio and television interference from the proposed 500 kV transmission lines would depend on distance of the receivers from the lines, strength of incoming radio and television signals, weather conditions, voltage level and

FIGURE III-13

Decibel Relationships

Sound pressure (μb)	Sound level (db)		Environmental conditions
		140	
1000	134		Threshold of pain
		130	
			Pneumatic chipper
		120	
100	114		Loud automobile horn (dist. 1 m)
		110	
		100	
10	94		Inside subway train (New York)
		90	
			Inside motor bus
		80	
1	74		Average traffic on street corner
		70	
			Conversational speech
		60	
0.1	54		Typical business office
		50	
			Living room, suburban area
		40	
0.01	34		Library
		30	
			Bedroom at night
		20	
0.001	14		Broadcasting studio
		10	
			Threshold of hearing
0.0002	-	0	

NOTE: The decibel (db) is defined as 10 times the logarithm to the base 10 of the ratio between two quantities of power. As the sound power is related to the square of the sound pressure a convenient scale for sound (noise) measurements is defined as:

$$\text{Sound Pressure Level} = 10 \log \left(\frac{p^2}{p_o^2}\right) = 20 \log \left(\frac{p}{p_o}\right) \text{db}$$

where p is the sound pressure being measured and p_o is a reference sound pressure, normally taken to be 0.0002 microbar (μb). The term level has been introduced in the above equation indicating that the given quantity has a certain level above a certain reference quantity (0.0002 μb = 2×10^{-5} N/m^2)

other factors. Most radio interference occurs in the AM broadcast band (535 to 1605 kilohertz). It has not been a problem in the FM broadcast band (88 to 108 megahertz). Radio interference levels would be expected to increase 17-24 db during inclement weather. The most obvious impact on radio reception would occur where power lines cross or would be extremely close to highways, railways, and communities.

Television reception is more often impacted by faulty insulators, sharp edges on metallic fittings and snow or heavy rains. VHF low band Channels 2 - 6, experience some interference in areas of weak signals. This interference may require people near the line to invest in more expensive antennas with better interference rejection capabilities. Other television channels are seldom affected by power lines. An additional electrostatic impact would be the effect of voltage gradient, which induces a voltage onto ungrounded objects near the line. This induced voltage depends on line voltage, insulation, line height, object conductivity and size of the object.

People near the transmission lines or substations may be subjected to "capacity discharges" which occur when two bodies of different electrostatic potential come in contact. This discharge is similar to the discharge generated by static electricity as a person walks across a nylon carpet.

Ungrounded metal objects near a transmission line may become charged and acquire an electrostatic potential. A person could notice a slight tingling sensation when touching such objects. The degree of discomfort is dependent on the area of the surface of the ungrounded object, its closeness to the ground, and its distances from the conductor.

Induced voltage may also cause gasoline vapors to ignite although, at the 500 kV level, sufficient voltage is not induced to cause this, even if large trucks were to refuel near the lines.

Impacts on segments of the transmission system

Kaiparowits to Phoenix

The proposed route would require 300 miles of temporary roads, plus about 950 tower sites. During construction, dust and automotive pollutants would be the main source of air quality degradation.

Slash accumulation, particularly in Prescott National Forest, would cause a moderate, temporary degradation of local air quality if burning would be allowed or an accidental fire would be started.

Kaiparowits to Navajo

This proposed route would require 140 miles of temporary roads plus 150 tower sites. Impacts on air quality would be similar to those described for the Kaiparowits to Phoenix route.

Kaiparowits to Eldorado

Most of the impact along this route would result from construction of 335 miles of new roads and 1,000 tower sites, plus pollutants from machines used in construction, including automotive and stationary machines, and helicopters.

In several localities along this segment, as noted in Chapter II, these impacts would be in addition to present air degradation caused by industrial activity, urbanization and mining. These localities are: Fredonia, Arizona (oil refinery); Moapa, Nevada (coal-fired electric generator); Johns Manville Plant (gypsum board); Apex, Nevada (limestone operation); Henderson, Nevada (industry); Las Vegas, Nevada (urbanization); and Eldorado Valley, Nevada (mining).

If vegetative debris cleared from roads and tower sites were accidentally burned it could cause a moderate, temporary degradation of local air quality.

Kaiparowits to Moenkopi to Mohave

This route would require 318 miles of new roads and about 1,175 tower sites, and would expose surface areas highly susceptible to wind erosion. The cumulative impact of dust and automotive pollutants near the route at Kingman, Arizona, and at the Mohave generating plant could be significant because of existing air pollution. Slash accumulation in the Tusayon district of Kaibab National Forest could have the same impact as that described for the Kaiparowits to Phoenix segment. If fire occurred during inversion periods, smoke and gaseous contaminants would temporarily degrade air quality, and be visible to tourists at the Grand Canyon and along State Highway 164.

Mohave to Serrano

This portion of the proposed route is best discussed by segments, as was done in Chapter II.

In the Mohave Desert segment there would be about 99 miles of new permanent roads for access and on-site travel, and 86 miles of old roads, plus 1,250 tower sites. Major impacts include dust from construction of roads and tower sites, and dust and other pollutants from operation of automotive equipment on the roads.

The Coachella Valley segment would be more sensitive to air quality impacts because of existing air quality and climatic conditions (see Chapter II). This portion of the transmission route would add about 39 miles of new roads, and would include about 33 miles of old roads. It would add about 200 new towers. This would increase dust and engine emissions in an area already plagued with air pollution from the Los Angeles basin, plus sand storms and air pollution locally from a major freeway. There would also be some residual impact after construction. The new roads would be used as access routes by ORV users, adding more pollutants to the air.

The Valley segment, from Devers substation to Serrano, would require about 79 miles of new, permanent roads and would use about 14 miles of existing roads. About 575 towers would be required. Dust and pollutants from internal combustion engines would add to an already serious air quality condition in this area. There would be some accumulation of vegetative debris in the portion of the line through Cleveland National Forest and on to Serrano substation.

Maintenance activities and ORV problems further east may not have the same impact on this portion of the line because much of the private land and national forest would not be open to unregulated use. Overall, however, the above additions to air pollution would be insignificant compared to existing conditions.

Northern Kaiparowits to Mohave preferred alternate

Impacts on this route would be the same, in most regards, as along the Kaiparowits to Eldorado proposed route. The two routes parallel each other, with a 2,000-foot separation.

The major impact on air quality of this proposal would be dust pollution from construction of the 339 miles of new, permanent roads, plus the additional tower sites.

If slash were accidentally burned along this route, the impact on local air quality would be moderate, for a brief time. Residual impacts on air quality from road use would be minimal.

Arizona Strip preferred alternate

Impact on this preferred alternate route would be very much the same as on the Northern Kaiparowits to Mohave preferred alternate, as far as air quality is concerned. Major impacts would be temporary, including those of road construction and tower site clearance.

From Seegmuller Mountain through the Virgin Mountains, a distance of 40 to 50 miles, some heavy stands of pinyon-juniper would be crossed and there would be substantial accumulations of slash material. If this were burned, a temporary degradation of air quality would occur.

Residual impacts from use of access roads and maintenance of tower lines would be minimal.

Limestone quarry impact area

Rock and crushed stone products would be loosened by drilling and blasting. Loosened material would then be removed by earth-moving equipment. The drilling, blasting and transfer could raise considerable dust. Largest portion of such dust would be heavy particles and, as such, would mostly settle in the quarry area.

Such fugitive dust would be a nuisance to workers, but would be short-lived, causing only local air quality degradation, and aesthetic impact by deposition on vegetation near the operation.

Gaseous emissions would come from the engines of limestone haulage trucks, power drills, and other equipment. In an area now little disturbed by human activity, the impact of such emissions would be expected to be felt only in the immediate vicinity of the road. Emissions would be dispersed by air movement with only minor impact.

The proposed quarry site is remote and low in background noise levels. Increased activity associated with quarry operation - such as drilling, blasting, loading, and transport - would increase noise levels significantly. Blasting has the potential for disturbance over large distances, even to surrounding communities. Such noise levels could be an intrusion on recreational activities and associated facilities at Bryce Canyon. Other quarry activity would be quieter, with more localized impact, but more continuous.

GEOLOGY AND TOPOGRAPHY

Kaiparowits Plateau impact area

Topography would be altered in areas occupied by structures and facilities. However, the effect of these alterations upon the human environment would be insignificant. Greatest impact on geology in the Kaiparowits Plateau impact area would result from removal of large quantities of coal from the geologic section in the mine area.

Where full retreat, longwall, or shortwall mining methods are used for a high percentage of coal extraction, rupturing and collapse of overlying sedimentary rock is inevitable. Loss of support and gravity would cause overlying formations to sag until the surface downwarps. This phenomenon, termed subsidence, is also defined as "the sinking, descending or lowering of the surface of the ground" (Cummins and Given, 1973). See Illustration III-3.

Depending on the degree of recovery and depth of coal, some subsidence of overlying formations and resultant deformation and lowering of the surface would affect local topography.

Since there are virtually no past mining records and engineering data on the Kaiparowits coal field from which to form a logical basis, it is impossible to accurately assess the degree of subsidence that might be ultimately expected should the proposal be implemented. The magnitude of this impact can be predicted, however, by applying some comparisons and principles derived from results of mining elsewhere.

The type of subsidence to be expected in most of the proposed project coal mine area is referred to as trough subsidence (Illustration III-3). Depending on the angle of draw, the surface affected is greater than the area of coal extracted. In Europe this angle has been found to be about 35 degrees. However,

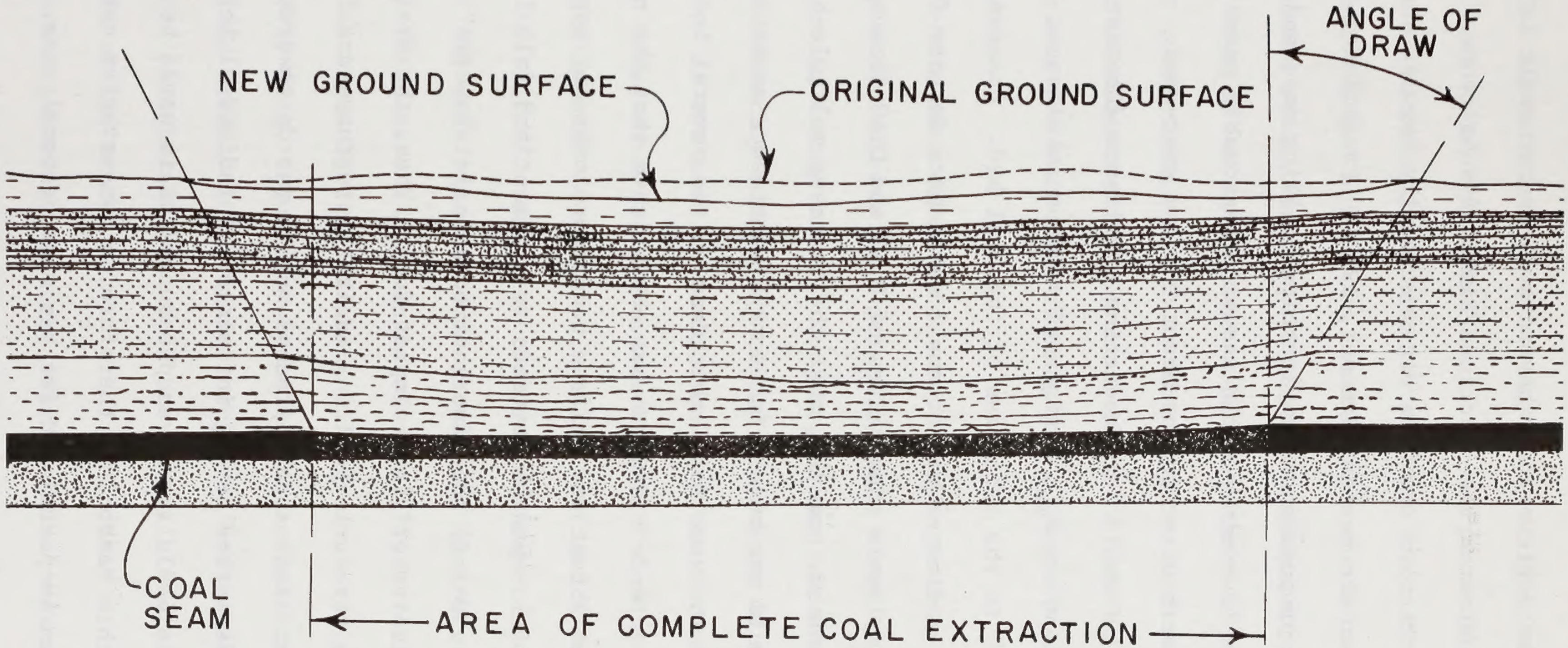


ILLUSTRATION III-3

Section Showing Trough Subsidence and Angle of Draw

a subsidence effect or angle of draw beyond a 25 degree angle is so small that the latter may be considered the practical limit of subsidence.

When an extraction area has a geometrically regular shape, maximum subsidence occurs over the center (Brauner, 1973). Preliminary descriptions and layout of the mining proposals and exploration drilling maps and data, indicate that collectively the four mines would assume a reasonably geometric shape, about 7 miles in a north-south direction by about 9 miles east-west.

The general formula for predicting subsidence (Brauner, 1973) is as follows: $S_{max} = a \cdot m$, where S_{max} designates maximum subsidence, "a" is the subsidence factor, and "m" is the thickness of the coal bed. Observation in other American coal fields indicates rather small subsidence factors for caving. Measurements in Pennsylvania show values of 0.50 and 0.60 (Brauner, 1973).

It is theorized, however, that the proposed multiple-bed mining of Kaiparowits coals would not result in as much subsidence as would single coal bed extraction, equal to the same total thickness as the several individual beds.

Mining experience elsewhere has established that the caving nature of rock strata is not an abrupt and uniform occurrence over any appreciable area. Rather, as the material ruptures it tends to fragment and fall indiscriminantly into the void. In so doing, the disorganized material "swells" or occupies more volume than it did in its original compact form. Thus, the available space for succeeding overlying strata to fill in, as it too ruptures and fragments, becomes progressively less and less as the process moves upwards towards the surface. Consequently, the respective caving influences of individual thinner voids on the overall vertical mass would not be as pronounced as it would be for the single bed situation. By this reasoning, therefore, a conservative subsidence factor of about 0.4 or less can be postulated for the mine proposal area.

Drill-hole data indicate the aggregate of the Orange, Upper and Lower Red, and Brown coal beds, over the "heart" of the proposed mining area, where all four beds occur in minable thickness, varies from about 30 to 40 feet in thickness. Due to irregularities and nonuniform strata above and below the coal beds, total vertical extraction would, in all probability, aggregate only about 25 to 35 feet over the prime "center" of operations. Assuming from drill hole data that the four beds occur consistently enough to mine over an area within a radius of about 1 mile, maximum subsidence would be about 10 to 14 feet in this area, centered approximately along the west edge of Section 7, Township 41 South, Range 4 East, Salt Lake Meridian.

Drill-hole data derived from exploration towards the edges of the proposed mining area indicate that generally only three of the four beds are of minable thickness in fringe areas. However, in any one area those three minable beds will not necessarily correspond to the occurrence of three minable beds at another extremity of the area. Examination of these irregular data indicates, therefore, that total minable thicknesses will fall into a range of about 20 to 30 feet. After allowance is made for similar roof and floor irregularities, application of the formula indicates that maximum subsidence expected in the greater part of the mine area would be about 5 to 10 feet, with rapid feathering-out in the zone influenced by the angle of draw (Illustration III-3).

With an angle of draw of about 25 degrees, originating at an average depth of about 650 feet, the width of the influence zone on surface affected by subsidence, beyond actual mining limits, would be about 275 feet. However, this relatively narrow peripheral zone would be virtually indiscernible along the 63 square mile area of influence.

The broad subsidence pattern over the mine area would most likely assume a concave or "dish-like" shape hardly perceptible to the naked eye, in

most instances, because it would be extended over a relatively wide area. However, the overall depression could act as a large water catchment basin or a series of smaller basins, where existing drainages are not sufficiently close or extensive to provide natural drainage.

Subsequent percolation of water through underlying strata could result in contamination of any aquifers still capable of carrying water. If subsidence has caused severe fracturing of the strata, however, aquifers could be sufficiently damaged to lose their water-transportation ability, drying up springs in the area. Entrapment of surface water in the subsidence areas could have a favorable impact, providing moisture for vegetation.

Conversely, where overburden is relatively thin (100 feet or less), such as in canyon bottoms, drainages and under canyon rims, full extraction of the coal could result in the caving breaking through to fracture the surface in an irregular manner, making the surface unattractive and jagged. Moreover, this would not only be hazardous to life and property in the mines because of the potential for storm runoff flooding underground areas, but to human and animal life on the surface as well. Altering of the surface could also change drainage patterns, causing more erosion.

The geology of areas excavated for ponds and reservoirs would be affected by the removal of material to create these basins. Similarly, the geology of aggregate sources would be permanently affected by the removal of about 1,600,000 cubic yards of material from the pre-project geologic section.

Disturbance of soil and rock for road cuts, buried pipe line and conveyor routes would also affect geologic formations along these rights-of-way, but insufficient data is available to quantify these impacts. However, fresh exposures of geologic formations often enable geologists and engineers, as well as the everyday traveler, to better understand the local environment.

Implementation of the proposal would result in mineral development becoming the major land use in the southern Kaiparowits Plateau. The plateau would be transformed from an area of minor mineral development to one of the largest volume underground coal mining operations in the United States. At full operation, more coal would be mined in one day (approximately 52,000 tons) than was mined by all small local mines in the area during the past half century (approximately 24,000 tons).

On an annual basis, 12 million tons of raw coal would be mined, of which 9 million tons of clean coal would be delivered to the generating station following the necessary coal preparation phase as described in Chapter I under "Coal mine facilities."

Over the 35-year amortized life of the proposal, 420 million tons of raw coal would be mined. However, due to limitations in mining technology, by current standards it is estimated that only about 50 percent of the original in-place coal underlying the area proposed to be mined would be recovered. This estimate takes into account that extraction of 90 percent or more of any one minable bed may be achieved locally by application of proven and highly successful current mining methods such as the longwall technique. However, on a mine-wide basis, overall recovery is reduced because of ground control problems, protective pillars for haulage ways, etc.

Because of the nature of underground caving and resultant high contamination, any future recovery of the equivalent 420 million tons left behind in the ground is not considered feasible by present technology, and therefore must be considered in this analysis as lost.

Coal losses can be attributed to four categories: (1) coal left in place to provide surface protection against subsidence, (2) coal unmined because the beds are too thick for safe recovery, (3) coal unmined because beds are too

thin to be safely or economically recovered, and (4) coal unmined because multiple coal beds are in such close proximity that all beds cannot be safely recovered.

The estimated 92 million tons of coal about 1,900 feet beneath the proposed Fourmile Bench power plant site would not be mined as long as an operating plant is on this site.

Transmission system impact area

Primary proposal, Arizona Strip proposal, Northern Kaiparowits to Mohave proposal

Topography would undergo slight modification during construction of transmission lines. These modifications would result from use of sand and gravel for concrete and construction of access roads, tower sites and crane pads.

Concrete would be required for tower footings and microwave station foundations. Amounts of mineral aggregate (sand and gravel) needed to produce this concrete are tabulated in Figure III-14. Use of mineral aggregate along any segment of the transmission line system would result in modification of just over 1 acre of topography. Since use of aggregate would be spread out, the amount of surface modified at any one aggregate source would probably be a small fraction of an acre. Exact sources of aggregate have not been identified. Because of the large amounts of aggregate available in one area, this use would constitute an insignificant commitment of the resource.

FIGURE III-14

Aggregate Needed for Transmission System Construction

	Cubic yards of Aggregate needed	Acreage of topography modified, assuming a 3-yd depth of excavation
Kaiparowits-Eldorado	6,055	.4
Kaiparowits-Moenkopi-Mohave	7,243	.5
Mohave-Serrano	13,151	.9
Kaiparowits-Westwing	5,465	.4
Microwave stations	330	.02
Totals	32,244	2.22

Construction of access roads in rough terrain could be the major activity causing modification of topography. Approximate mileages of such rough terrain which would be crossed by lines under each proposal are: 112 miles for the primary proposal, 100 miles for the Arizona Strip proposal, and 104 miles for the Northern Kaiparowits proposal. However, the exact amount of topography which would be modified along any proposed route cannot be calculated until the participants prepare a transportation plan showing the location of access roads. It is estimated that modified topography for any proposal would amount to a few hundred acres.

Construction of tower sites and crane pads would cause slight modification of topography in rough terrain. It was assumed that there would be 3.2 tower sites and crane pads per mile; each tower site would cover .037 acre, and each crane pad would cover .13 acre. The acreages of modified topography for each proposal are tabulated in Figure III-15. These are considered to be the maximum acreages of modified topography. Actual acreages would be somewhat less, because some tower sites and crane pads could be located on level areas within a larger area of rough terrain.

FIGURE III-15

Topography Modified by Tower Sites and Crane Pads

	Tower sites (permanent)	Crane pads (temporary)
Primary proposal	13 acres	47 acres
Arizona Strip proposal	12 acres	42 acres
Northern Kaiparowits proposal	12 acres	43 acres

Limestone quarry impact area

More than 13 million tons of material (about 6.5 million cubic yards) would be removed by quarry operations during the life of the project. Of this, about 4.5 million tons of waste rock and topsoil (about 2.25 million cubic yards) would be returned to the pit for shaping, grading and rehabilitation. A pit or pits, ultimately covering about 130 acres and about 30 feet deep, would result. Steep slopes and benches would be graded.

SOILS

Kaiparowits Plateau impact area

Introduction

Five major parts of the proposal were analyzed as to soils-related impacts. These are generating station and support facilities - new highway - coal mine and support facilities - new town - and other aggregate sites. Figure III-16 identifies acreage that would be disturbed during the construction phase of each component, and the area permanently occupied by man-made improvements after construction. During construction about 9,460 acres would be disturbed; after construction an estimated 7,320 acres would be occupied by some type of improvement.

Figure III-17 identifies calculated amounts of runoff and sediment expected at the facilities during and after construction. Main considerations in the following analyses are the possible effects of 2-year and 50-year storms of 6-hour duration, effects of salt deposition from cooling towers, and influence on estimated sediment yield. A more detailed description of the analyses can be reviewed in the Appendix III-6.

The storms chosen were of a 6-hour duration occurring on the average, once every 2 years and once every 50 years respectively. The 6-hour duration was chosen because of the high intensity that usually causes runoff. The 2-year frequency storm was used to illustrate the most common storm that would occur during the project life, that would produce runoff. The 50-year frequency storm was used to illustrate the maximum effects of a storm that could occur during the life of the project.

No analysis regarding the impacts to soil structure, water retention, productivity and soil microorganisms was attempted. The soils are presently a single-grain structure, which would not change during disturbance and therefore would not result in any measurable decreases in water retention and productivity.

FIGURE III-16

Present Estimate of Areas Affected by
Kaiparowits Power Proposal

Fourmile Bench Power Plant Proposal	Acres disturbed during construction	Acres permanently occupied after construction
Generating Plant		
1. Power block including switchyard	330	80
2. Coal storage	Incl. in 1	70
3. Fuel oil storage	Incl. in 1	10
4. Cooling Towers	Incl. in 1	5
5. Evaporation ponds	220	180
6. Buildings and parking	Incl. in 1	5
7. Ash disposal	450	450
8. Ash disposal reservoir	30	30
9. Ash haul road	5	5
10. Water storage reservoir	130	90
11. Retention pond	5	5
12. Limestone Preparation Plant	2.0	2.0
Subtotal	1,172	932
Water pipe line		
1. Pipe line	530	175
2. Pump station (lake)	5	5
3. Pump station (Nipple Bench)		
4. Patrol road	85	45
5. Power line	Incl. in 4	Incl. in 4
Subtotal	620	225
Access road to aggregate site (power plant)	20	15
Aggregate site (power plant)	70	70
New highway (67 miles)		
1. Glen Canyon City to Fourmile Bench and coal mine (37.2 miles)	225	155
2. Fourmile Bench to Cannonville, Utah (29.8 miles)	180	125
Subtotal	405	280
New town	5,000	3,900
Other aggregate sites	330	247

(continued)

FIGURE III-16
(concluded)

Coal mine (John Henry Bench)	Acres disturbed during construction	Acre permanently occupied after construction
1. Four mine portals	92	92
2. Washery and silos	50	17
3. Central administration complex including permanent storage and water reservoir	50	50
4. Coarse refuse dump	550	550
5. Tailings pond	550	550
6. Clear water pond	23	23
7. Sewage pond	60	60
8. Ventilation fans	4	4
9. Temporary coal storage area	75	---
10. Corridors (roads, conveyor, etc)	210	140
11. Main access road	150	150
12. Utah Power & Light 138 kV Power line		
a. Transmission lines	22	8
b. Substations & Communication Facilities	5	5
c. Right-of-Way		
(1) Permanent - 213 acres		
(2) Temporary - 29 acres		
d. Length	(Incl. in 12.a.)	(Incl. in 12.a.)
(1) Permanent - 22 miles		
(2) Temporary - 3 miles		
e. Access roads - 14 miles	(Incl. in 12.a.)	(Incl. in 12.a.)
f. Material Storage - 5 acres	(Incl. in 12.a.)	
Subtotal	1,841	1,649
TOTAL - All Areas	9,460	7,320

FIGURE III-17

Acre-Feet of Runoff and Sediment for 2-year and 50-year, 6-Hour Storm Prior to, During and After Construction

Facility	Storm Runoff: Prior 2-Yr	Prior 50-Yr	During 2-Yr	During 50-Yr	After 2-Yr	After 50-Yr	Estimated Annual Sediment: Prior	During	After
Generating station and support facilities	0	8.90	1.84	34.10	6.40	42.80	0.84	1.16	0.53
Water pipe line	2.31	15.96	4.24	24.44	3.13	18.76	0.45	0.50	0.48
Aggregate site and access road	0.01	0.41	0.05	0.85	0.23	1.11	0.016	0.022	0.019
New highway	1.30	10.68	3.81	17.90	8.06	34.89	0.47	0.56	0.52
Coal mine and facilities	0.61	15.19	3.23	37.73	16.65	42.96	1.20	1.47	0.31
New community	0.64	54.08	5.12	147.12	40.61 (31.40 to 51.50)	223.25 (201.60 to 246.40)	3.50	4.63	4.10
Other aggregate sites	0.05	1.93	0.24	4.01	1.08	5.23	0.08	0.10	0.09
Total	4.92	107.15	18.53	268.15	76.16 (66.95 to 87.05)	369.00 (347.35 to 392.15)	6.56	8.44	6.05

There is no known information regarding the effects of pollutants on soil microorganisms including soil bacteria; therefore, subsequent impacts would be strictly theoretical and possibly invalid.

Generating station and support facilities

The generating station and its support facilities would consist of the power plant, construction and pump power line, communication power line, the water pipe line and access road from Lake Powell, and the aggregate site and access road in the upper Wahweap Creek drainage. Each of these facilities is analyzed and discussed below.

Power plant

The power plant would be on what is considered the Deep Plateau Soil Association. During construction of the plant and support facilities some 1,172 acres or 1.83 square miles would be disturbed. After construction some 932 acres or 1.45 square miles would be occupied by some type of structure, pond, disposal site or road.

During construction the runoff from a 2-year, 6-hour storm would increase by 1.84 acre-feet, due to the removal of vegetation, and increase another 4.56 acre-feet after construction due to the presence of 175 acres of impervious surface.

When considering a 50-year, 6-hour storm, runoff would increase by 25.2 acre-feet during construction, and increase another 8.7 acre-feet after construction due to impervious surfaces. Annual sediment would be increased by an estimated 0.32 acre-feet during construction and decrease by 0.21 acre-feet from present sediment yield after construction. The final decrease is due to creation of impervious surface and pond areas. Runoff and sediment would flow into Warm Creek drainage. The change in runoff and sediment deposition in the Warm Creek Drainage is considered insignificent as it amounts to less than 1-percent change

from present estimates. (See sections on water quality and wildlife for further discussion of sediment impact.)

The participants propose setting aside 450 acres at the head of Wesses Canyon for disposal of fly ash and residue from the sulfur dioxide scrubbers. Scrubber residue would consist primarily of calcium sulfate, whereas the fly ash would contain such toxic trace elements as barium, boron, fluorine, strontium, titanium and vanadium. Figure III-18 shows concentrations of the various trace elements that would be mixed in the bottom ash, fly ash and scrubber residue. The main cementing agent, calcium sulfate, has a solubility of 0.209 grams per 100 cubic centimeters of cold water. This means that although the ash disposal area may be covered with 1 foot of topsoil, the residue could become wet, and the amount of trace elements released could be greater than known toxic levels naturally found in the undisturbed native soils.

FIGURE III-18

Concentrations of Trace Elements in Parts Per Million in the Bottom and Fly Ash and Scrubber Residue as Compared to Kaiparowits and Western Soils

Trace Element	Bottom & Fly Ash & Concentrations	Bottom Ash, Fly Ash Scrubber Residue Concentrations	Concentrations Naturally Found in Soils: Kaiparowits Sandy Loam[a]	Concentrations Naturally Found in Soils: Average of Western U.S.[b]
Arsenic	8.8	6	---[c]	---
Barium	2,290	2,083	---	560
Boron	1,400	1,250	---	22
Flourine	594	433	---	---
Lead	47	34	46	16
Mercury	0.0016	0.0015	---	---
Selenium	31	22	---	---
Strontium	560	508	126	120
Titanium	3,000	2,723	1,400	2,500
Vanadium	111	80	67	66

[a] Analyses by Dr. Willis Brimhall, geochemist, Brigham Young University
[b] U.S.G.S. 1971
[c] No data available

The fly ash-scrubber residue would be covered with a foot of soil and revegetated. However, due to shallowness of soil placed on this area, and a low rainfall of 9 inches a year, the probability of annual seeding success would be less than 3 out of 10 years (Hagihara, et al., 1972).

Roots of plants, however, would penetrate the 1-foot soil mantle over the fly ash-scrubber residue site in a few years. Although it cannot be quantitatively evaluated at this time, toxic effects of heavy metals, mainly vanadium, selenium and barium, could be taken up by the roots of plants. Selenium is toxic to domestic livestock and wildlife when they eat grasses and small grains growing on soils with a concentration of at least 1 part per million of selenium (Williams and Walther, 1974). The disposal area would no longer be suitable for grazing.

Erosion of soil at the fly ash-scrubber residue site would greatly increase on the 4:1 side slopes planned. A change of slope from 0 to 25 percent increases velocity (v) 5 times, which in turn increases the potential sediment-carrying capacity 328 times ($v^{3.6}$) (King, 1971). The 4:1 side slopes around the site are predicted to occupy 124 of the total 450 acres. The present sediment runoff rate has been estimated at 0.5 acre-foot per square mile a year, or 0.009 inches per acre a year. Assuming vegetation could be reestablished to the present condition, the sediment rate on side slopes would be 164 acre-feet per square mile per year, or 3.10 inches per acre per year. At this rate it would take only 4 years to remove the foot of topsoil from the side slopes, after the area has been abandoned.

If vegetation cannot be established, side slopes would develop a sediment rate of 230 acre-feet per square mile per year, or 4.3 inches per acre per year. At this increased rate, it would take only 3 years to remove the foot of topsoil from side slopes after abandonment. After fly ash-scrubber residue is exposed, assuming a solubility of 0.209 grams per 100 cubic centimeters cold

water, under normal conditions approximately one-sixteenth of an inch would be washed off each year. After 50 years, this would amount to 0.25 acre-feet per acre washed into the drainage system.

The proposed erosion-control reservoir at the head of Wesses Canyon, and the planned drainage ditch around the fly ash-scrubber residue site, should not fail if properly constructed and maintained: However, considering topography around the disposal area, a natural drainage falls from the southeastern edge of the fly ash-scrubber disposal site into Wesses Canyon, just below the proposed flood control reservoir. Should the drainage ditch bordering the fly ash-scrubber disposal site silt-in from erosion of an estimated 30 acres of side slopes in the southeastern segment, then soil material would make its way into Wesses Canyon by way of natural drainage. The silting-in of the drainage ditch is a possibility, since each linear foot would have to store an average of 13.75 cubic yards of topsoil which could erode from the side slopes. Transport of fly ash-scrubber residue and trace elements to Lake Powell would continue for a number of years after abandonment of the facility as well as any detrimental effects they would have on aquatic life and water quality.

Deposition of salt in the soil by drift from cooling towers varies from 0.5 pounds to 250 pounds per acre per year, depending on distance from the towers. The top 6 inches of soil would be most adversely affected by salt accumulation (Richard, 1954). Such accumulation would not have a straight-line relationship to drift deposits, because of loss through surface runoff. For purposes of analysis it was assumed that 5 percent of the salts deposited each year would be lost through surface runoff. It was also assumed that salt accumulation, expressed in millimhos of electrical conductivity (EC x 10^3), establishes definite limits for growth of native vegetation (Bernstein, 1958; Gates, et al., 1956; Richards, 1954). The effects of salt drift were added to the known electrical conductivity of 1.1 x 10^3 millimhos of the soils.

Sagebrush and pinyon-juniper have an average upper limit of salt tolerance of 4×10^3 millimhos. Most grasses and forbs have an average upper limit of 6×10^3 millimhos, with 12×10^3 forming the dividing line between them and salt tolerant shrubs and herbaceous vegetation, and 16×10^3 being the upper limit for the salt-tolerant shrubs.

Figure III-19 shows acreages that would be affected by salt drift from cooling towers, and resulting increases in runoff and sediment production for selected years of operation.

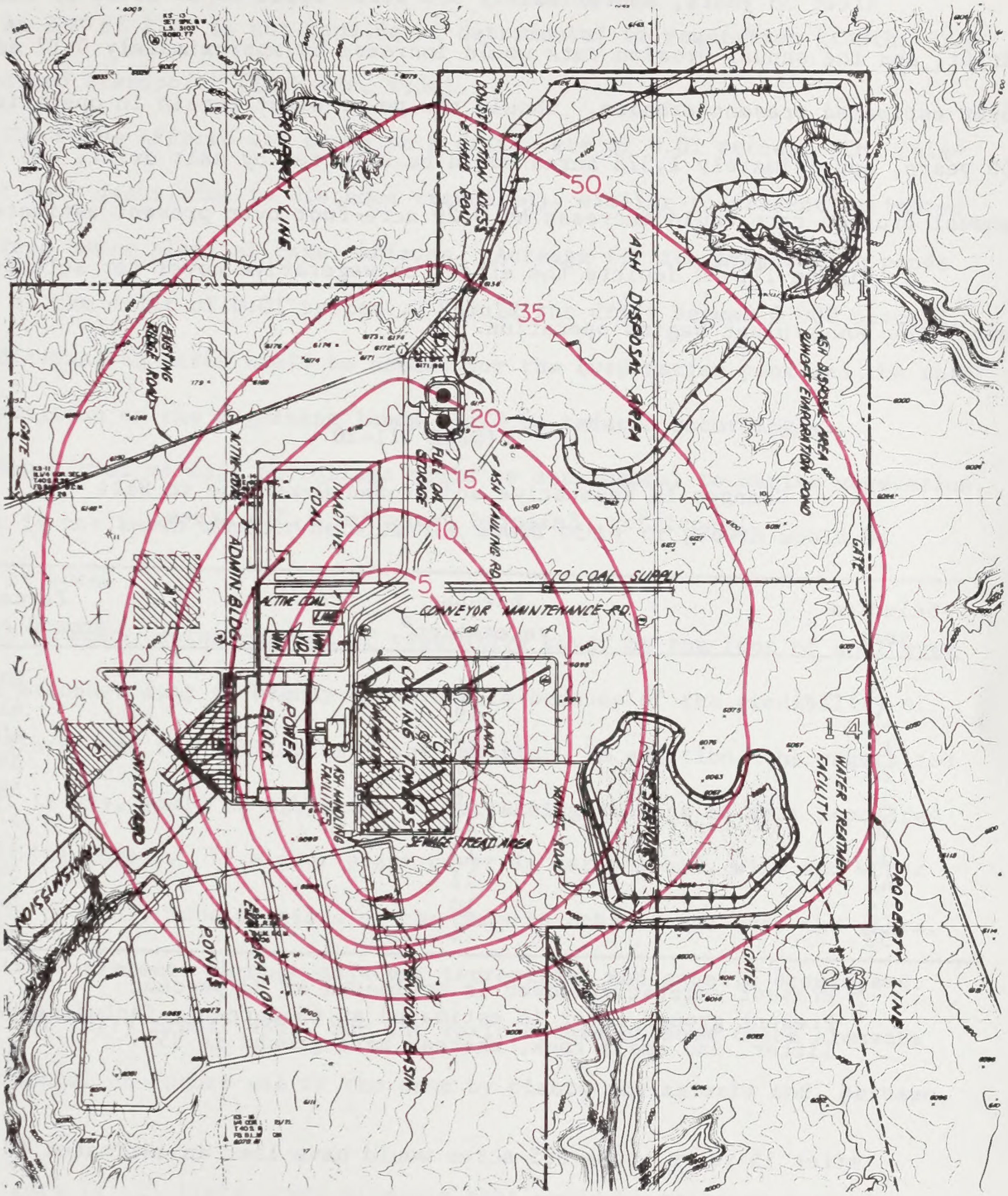
FIGURE III-19

Acres Affected by Salt Deposition and Resultant Increase in Runoff and Sediment on Fourmile Bench

Years after cooling tower begins operation	Estimated acres affected[a]	Increased runoff for selected 6-hr. storms in acre-feet		Increased sediment in acre-feet	
		2-year	50-year	Annual	Accumulated
5	140		1.98	0.03	0.09
10	285		4.03	0.06	0.18
15	335		4.75	0.07	0.21
20	485		6.87	0.10	0.30
25	540		7.65	0.11	0.33
30	640		9.07	0.13	0.38
35	805		11.40	0.17	0.50
40	905		12.82	0.20	0.59
45	1,075		15.23	0.23	0.68
50	1,375		19.48	0.29	0.86

[a] Does not include land taken by generating plant facilities. Pertains only to acres that will support vegetation after construction.

Illustration III-4 shows widening areas which would be adversely affected by salt drift after 5, 10, 15, 20, 35 and 50 years. Should the power plant remain in operation for 50 years, approximately two-thirds of the fly ash-scrubber residue disposal site would be affected, making it more difficult to establish or maintain vegetative cover on the foot-deep topsoil.



Areas Considered no Longer Suitable for Pinyon-Juniper and Sagebrush Due to Salt Deposition from Cooling Tower Drift for Periods Ending 5, 10, 15, 20, 35 and 50 Years After Power Plant has been in Operation (Developed from MRI, 1974)

ILLUSTRATION III-4

Salt Deposition
Cooling Tower Drift for Years Indicated

After 35 years, approximately 805 acres would be affected by salt drift, and the annual erosion rate would increase by approximately 0.17 acre-foot over estimated present erosion. Should the power plant remain in operation for 50 years, approximately 1,375 acres would be affected by salt drift, and the annual erosion rate would increase by 0.29 acre-foot over present estimates.

Figure III-20 depicts the effect on vegetative cover for selected years after the power plant begins operation.

FIGURE III-20

Changes in Vegetative and Ground Cover Due to Salt Deposition, Selected years for 1,375 Acres

Selected year	Percent vegetation[a]	Percent ground cover[b]
5	21	63
10	19	61
15	18	60
20	17	59
25	16	58
30	15	57
35	13	55
40	12	54
45	10	52
50	6	48

[a] Present vegetative cover is estimated at 23 percent
[b] Present ground cover is estimated at 65 percent, including vegetation, litter, and small rock, whereas bare ground is 35%.

After 35 years, some 805 acres would have lost an estimated 40 percent of the vegetative cover. Should the power plant operate for 50 years, some 1,375 acres would have lost an estimated 70 percent of the vegetative cover and 25 percent of the ground cover.

The sodium absorption ratio (SAR) for salt deposited in the soil was calculated at 2.42, based on the quality of water used in the cooling towers. A

more detailed description of water chemistry is presented in the water quality section. An SAR of 2.42 is not considered detrimental to vegetation growth, from a sodium hazard standpoint (Richards, 1954).

The above effects are based on a drift rate of 0.01 percent (the relationship of salt deposition to distance travelled), similar to present estimates for the Navajo power plant at Page, Arizona. Acreage for the evaporation ponds were based on the drift of 0.01 percent. Should the drift become 0.008 percent, then an additional 45 acres would be needed for the evaporation pond and the rate of salt deposition on the adjoining lands would be reduced accordingly.

Deposition of salt on foliage could be detrimental to native vegetation. However, it is not known whether defoliation would occur or growth would be inhibited, or both.

In summary, establishment of vegetative cover on the foot of soil over the ash and scrubber dump is highly questionable because of the erodibility of the 4-to-1 slopes and the shallow arid soil mantle. In addition, the vegetation established, if any, would be subjected to increasing amounts of salt deposited from the cooling towers. If a poor plant cover is established, wind and water erosion would probably move portions of the dump to other areas over the years, scattering trace elements through adjacent terrestrial and aquatic ecosystems. Impacts are not fully predictable, but the toxic nature of some trace elements may be detrimental to future use of the area by plants and animals and, perhaps, man.

Figure III-21 lists trace elements that would be released into the atmosphere from plant stacks and deposited on adjacent soils. For purposes of analysis, the assumption was made that most of these trace elements would be deposited uniformly in a 30-mile radius, under normal dispersal conditions and using an average-grade coal.

FIGURE III-21

Concentrations of Trace Elements

Trace Element	Pounds			Parts per Million		
	In Atmosphere		Acre/Year	Yearly Concentration in Soil	After 35 Years	After 50 Years
	Daily	Yearly				
Arsenic	15	5,475	0.003	0.002	0.07	0.10
Barium	56	20,440	0.011	0.008	0.28	0.40
Boron	34	12,410	0.007	0.005	0.18	0.25
Flourine	2,900	1,058,500	0.585	0.438	15.3	21.9
Lead	1	365	0.0002	0.00015	0.005	0.008
Mercury	4	1,460	0.0008	.0006	0.02	0.03
Selenium	50	18,250	0.01	0.008	0.28	0.40
Strontium	14	5,110	0.003	0.002	0.07	0.10
Titanium	74	26,280	0.015	0.011	0.39	0.55
Vanadium	3	1,095	0.0006	0.0004	0.01	0.02

[a] The concentrations are based on the assumption that the top 10 centimenter or 4 inches of soil will be affected (Williams and Walther, 1974).

Amounts of trace elements actually deposited could be less (Williams and Walther, 1974). In the case of fluorine, most would be deposited in the soil as calcium flouride or cryolite, which are stable compounds nontoxic to vegetation and not taken up by the root system. Fluorosis in animal life, which can be traced to ingested vegetation, is the result of gaseous fluorides in very high concentrations associated with smelter operations (Hill, 1969).

Almost all snow and rain falling on buildings and parking lots would run off onto adjacent areas. If the proposed drainage or other means of runoff dispersion should fail, gullies would be created and eventually connect with Wesses and John Henry canyons, particularly during storms of 10-year frequency, of a 6-hour or greater duration.

The probability of annual seeding success on the power plant site would be 3 to 5 out of 10, except on the fly ash-scrubber residue site where it would be less than 3 out of 10 years, because of the shallow 1-foot soil mantle.

Water pipe line

The water pipe line, a support facility for the power plant, crosses the Badland-Rockland and the Shallow and Deep Plateau Soil Associations.

During construction 620 acres (0.97 square mile) would be disturbed. After construction, 225 acres (0.35 square mile) would be occupied by pipe line, access roads, patrol roads, the conveyor system, and power lines. Figure III-17 presents the amounts of runoff and sediment that would be expected from the water pipe line facility.

During construction, estimated runoff from a 2-year, 6-hour storm would be increased by 1.93 acre-feet, due to absence of vegetation, and decreased 1.11 acre-feet after construction. This is 0.82 acre-foot higher than present estimates. The reduction would be due to restoration of disturbed areas along the pipe line and patrol roads.

In a 50-year, 6-hour storm, the estimated runoff would be increased 8.48 acre-feet during construction, and decreased 5.68 acre-feet after construction, but still 2.80 acre-feet higher than present estimates. The reduction would be due for the reasons stated for the 2-year, 6-hour storm.

Estimated annual sediment yield would be increased by 0.05 acre-foot during construction, and decreased 0.02 acre-foot after construction, still 0.03 acre-foot higher than present estimates. The sediment reduction would come from restoration of disturbed areas; however, the additional 0.03 acre-foot of sediment occurring after construction would be due to water movement down slopes and borrow areas from road surfaces. Runoff and sediment from pipe line construction would flow into Warm Creek drainage, while runoff and sediment from the patrol road would flow into the Wahweap Creek drainage. The greatest sources of sediment would be tropic shales to the southeast of Nipple Bench.

The probability of annual seeding success on disturbed areas along the pipe line and patrol roads would likely be less than 3 out of 10 years, on most of the area. An exception would be those soils having a higher water-holding capacity, with a probability of seeding success being 3 to 5 years out of 10 on Nipple Bench (see Soils Appendix III-9).

Aggregate site and access road

The aggregate site and access road would also support the power plant, although the sand and gravel could be used for the coal mine and highway construction. The proposed site is on the Deep Plateau Soil Association.

Existing jeep trails would have to be reconstructed for access into the proposed aggregate site on upper Wahweap Creek. The aggregate pit would be confined to the creek bed and would not present a runoff and erosion problem. Open pits in the creek bed would act as settling basins during storms. During storms above the aggregate site, water flowing into the pits would lose velocity

momentarily allowing any sediment to settle to the bottom. After a few storms all traces of the aggregate pits would be obliterated. As long as no channel straightening occurs there would be no damage to the downstream channel or Lake Powell. However, should the channel be straightened, Wahweap Creek would erode back toward upper reaches of the drainage system, depositing sediment in lower portions of Wahweap Creek and Lake Powell. Time involved and damage cannot be evaluated due to the complexity of the drainage system and the unpredictability and inconsistency of storm patterns.

Access road to the aggregate pit would disturb about 20 acres, or 0.03 square mile. After reconstruction, about 15 acres, or 0.02 square mile, would be occupied by road surface and borrow areas. Figure III-17 identifies the various amounts of runoff and sediment that would be expected from the aggregate access road.

During construction, runoff from a 2-year, 6-hour storm would increase by 0.04 acre-foot, and another 0.18 acre-foot after construction. Runoff after construction would be 0.22 acre-foot greater than present estimates. At least half the net increase would occur in the sagebrush areas.

Runoff from a 50-year, 6-hour storm would increase by 0.44 acre-foot during construction, and another 0.26 acre-foot afterward. Runoff after construction would be 0.7 acre-foot greater than present estimates. As in the case of the 2-hour storm, at least half the net increase in runoff would occur in sagebrush areas.

Estimated annual sediment yield would increase by 0.006 acre-foot during construction and decrease 0.003 acre-foot afterward. Estimated annual sediment yield after construction would be 0.003 acre-foot greater than present estimates. As in the case of storm runoff, most of the sediment increase would occur along borrow areas within the sagebrush stands. All runoff and sediment would flow into Wahweap Creek.

The probability of annual seeding success on the disturbed areas would be 3 to 5 years out of 10, due to low rainfall.

New highway

The new highway would cross the Deep Plateau Soil Association, Shallow Plateau Soil Association, Shallow Soil-Rock Outcrops and the Badland-Rockland Association.

During construction 405 acres (0.63 square mile) would be disturbed, assuming a disturbed area 50-feet wide. After construction, 280 acres (0.44 square mile) would be occupied by road surface and borrow areas, assuming a 35-foot road bed. Figure III-17 identifies the amounts of runoff and sediment that would be expected from the highway component.

Runoff from a 2-year, 6-hour storm would be increased during construction by 2.51 acre-feet and increased another 4.25 acre-feet after construction. Runoff after construction would be 6.76 acre-feet greater than present estimated runoff. The greatest runoff would occur along Wahweap Creek, Nipple Creek, the head of Tibbet Canyon, Wesses Cove, Pilot Knob and where the highway crosses Wesses Canyon to the coal mine.

Runoff from a 50-year 6-hour storm would increase by 7.22 acre-feet during construction and another 16.99 acre-feet after construction. Runoff after construction would be 24.21 acre-feet greater than present estimates. As with a 2-year, 6-hour storm, greatest amount of runoff would occur along Wahweap Creek, Nipple Creek, the head of Tibbet Canyon, Wesses Cove, Pilot Knob and Wesses Canyon.

Estimated annual sediment yield would increase by 0.09 acre-foot during construction, and decrease 0.04 acre-foot afterward. This is still 0.05 acre-foot higher than present estimates. The additional 0.05 acre-foot of sediment would come from water movement down slopes and borrow areas from road surfaces,

particularly on segments previously identified as producing the greatest runoff. Runoff and sediment from the Glen Canyon City-Nipple Spring portion would flow into Wahweap drainage. Most of the runoff and sediment from Nipple Spring to the power plant would flow into Warm Creek drainage.

Nipple Creek, the head of Tibbet Canyon, Wesses Cove, Pilot Knob and Wesses Canyon segments are the most sensitive to erosion and runoff because of moderately steep slopes, with shallow, fragile soils.

The probability of annual seeding success on the disturbed areas would be less than 3 years out of 10. Approximately three-fourths of the runoff and sediment would flow into Wahweap Creek drainage and the remainder would flow into the upper Paria River drainage between Cannonville, Utah and Grosvenor Arch.

Coal mine and support facilities

The coal mine would be on the Badland-Rockland Soil Association. The support facilities, consisting of a 138 kV power line from Butler Valley, would be constructed on Deep Plateau soils.

During construction 1841 acres or 2.88 square miles would be disturbed. After construction, 1,649 acres or 2.58 square miles would be occupied by roads, buildings, ponds, refuse dumps, mine portals and conveyors. Figure III-17 shows the amounts of runoff and sediment that would be expected from the coal mine component.

During construction, runoff from a 2-year, 6-hour storm would increase by 2.62 acre-feet, and increase an additional 13.42 acre-feet after construction. The increase would be 16.04 acre-feet after construction, compared to the present. The increase would come from impervious surfaces on buildings, roads and protective structures.

Runoff from a 50-year, 6-hour storm would increase by 22.54 acre-feet during construction, and another 5.23 acre-feet afterward. Increase in runoff

would be 27.77 acre-feet after construction, compared to the present. As in the case of the 2-year, 6-hour storm, increased runoff would be attributable to impervious surfaces on buildings, roads and protective structures.

Estimated annual sediment yield would increase by 0.27 acre-foot during construction, and decrease 1.16 acre-feet after construction. Net decrease in sediment production, compared to the present, would be 0.89 acre-foot. Impervious areas account for the net decrease in sediment production. All runoff and sediment would flow into Warm Creek drainage.

The probability of annual seeding success on disturbed areas around the coal washery and administrative buildings would be less than 3 out of 10 years, due to shallow soils and low rainfall. Remainder of the disturbed areas would have a probable seeding success of 3 to 5 years out of 10, due to low rainfall. However, should a subsidence of 15 to 18 feet occur, most of the runoff and sediment would be trapped on-site.

New community

The proposed new community would be located on the Sandy Soil Association.

A total of 8,960 acres has been requested for the new town; however, no more than 5,000 acres would be disturbed at any one time. About 3900 acres would be occupied by impervious surfaces such as streets, sidewalks, driveways, rooftops, and patios. Figure III-17 identifies amounts of runoff and sediment which would be expected from new community development. Because of the variability of impervious surfaces, a range is given for anticipated runoff from 2-year and 50-year storms of 6-hour duration.

During construction, runoff from a 2-year 6-hour storm would increase by 4.48 acre-feet, and increase an additional 26.28 to 46.83 acre-feet after construction. Total increase in runoff would be 30.76 to 50.86 acre-feet after construction, compared to the present. The total increase would be from impervious surfaces in the community.

Runoff from a 50-year, 6-hour storm would increase 95.04 acre-feet during construction, and an additional 52.48 to 97.28 acre-feet afterward. Net, final increase in runoff would be 147.52 to 192.32 acre-feet, compared to the present, from impervious surfaces in the community.

Annual sediment yield would increase by an estimated 1.13 acre-feet during construction, but then decrease by 0.53 acre-foot afterwards. Net annual increase in sediment production after construction would be 0.60 acre-foot. The drop in sediment yield at the end of construction would be from impervious surfaces that would have a tendency to stabilize the soil surface. However, overall increase in sediment production after completion, compared to the present, would come from natural drainages into Wahweap Creek.

Water for the new community would come from wells drilled into the Navajo sandstone. U.S. Geological Survey water analysis of a well at Glen Canyon City, Utah, drilled into the Navajo sandstone, showed the water would not be detrimental to soil when used for irrigation in the community (see water analysis in Chapter I). Electrical conductivity of the water is 477 micromhos (477 x 10^6), indicating a low to medium salinity hazard. Sodium absorption ratio for the water is 3.1, which indicates a low alkali hazard (Richards, 1954). Indicated hazards would be too low to inhibit native or introduced vegetation.

Soils on the north side of U.S. Highway 89, which would bisect the proposed community, are favorable or exhibit only a minor limitation for sewage lagoons, dwellings, shallow excavations, sanitary landfill, roads and streets. Good performance and low maintenance can be expected from the above-mentioned facilities, if placed north of U.S. Highway 89.

However, soils south of U.S. Highway 89, in the immediate vicinity of Glen Canyon City, Utah, contain gypsum deposits. Where these gypsum deposits occur, the soils have moderate limitations for sewage lagoons, dwellings, shallow excavations, sanitary landfill, roads and streets, because of soil instability

and potentially high shrink-swell ratios. These limitations can be overcome or modified through special planning, design or increased maintenance (see Appendix for a detailed description of soil limitation ratings).

The probability of establishing vegetation on disturbed areas would be 3 to 5 years out of 10 because of the low water-holding capacity of the soils.

Other aggregate sites

Based on projected needs for the coal mine, new community and new highway, an additional 330 acres of aggregate sites will be needed. Specific locations for these sites have not been identified. It is anticipated that these sites would be on the lower Wahweap drainage, Paria River drainage and Horse Mountain. These aggregate sites could be on any of the five soil associations in the Kaiparowits Plateau impact area. Probability of annual seeding success would vary from less than 3 years out of 10 up to 5 years out of ten.

For analytical purposes, an analogy was made between the 70 acres of identified aggregate sites and the 330 acres of unidentified aggregate sites.

During construction, runoff from a 2-year, 6-hour storm could increase by 0.19 acre-foot, and increase another 0.84 acre-foot after construction. Net runoff after construction would be 1.03 acre-feet greater than at present.

Runoff from a 50-year, 6-hour storm would increase by 2.08 acre-feet during construction, and other 1.22 acre-feet afterward. Runoff after construction would be 3.30 acre-feet greater than at present.

Estimated annual sediment yield would increase by 0.02 acre-foot during construction, and decrease 0.01 acre-foot afterward. Net annual sediment yield after construction would be an estimated 0.01 acre-foot greater than at present.

An estimated three-fourths of the runoff and sediment would flow into Wahweap Creek drainage, and the remainder would flow into the upper Paria River drainage.

Summary of impacts

Individual effects of runoff and sediment production have been identified earlier in this section. However, there are possible cumulative effects on Lake Powell. Figure III-22 shows only runoff from the impact areas, when subject to a 50-year, 6-hour storm. This could not be related to drainage areas involved, as their flow for a 50-year storm is unknown. During construction, runoff from this storm would average an additional 150.25 percent of normal. After construction, runoff would average an additional 224.17 to 265.84 percent of normal, because of large areas of impervious surfaces.

On the 1,375 acres affected by salt accumulation from cooling tower drift, additional runoff would flow into Warm Creek. Figure III-23 shows projected runoff from the salt-accumulation area for selected years. Should a 50-year storm occur the fifth year after cooling towers begin operation, runoff would be the same as for a 50-year storm during construction of the power plant. Should the 50-year storm occur after 50 years, runoff would be 58.52 percent greater at the power plant site than at present.

Figure III-24 relates to the drainages and possible impact on Lake Powell. Runoff from the salt-accumulation area for a 2-year, 6-hour storm would not be significantly increased, even after 50 years, since at least an average 74 percent of original ground cover would remain. Based on present estimates, runoff in Warm Creek drainage would increase 0.70 percent during construction, and 2.52 percent afterward. Runoff in Wahweap drainage would increase 0.30 percent during construction, and 1.74 to 2.75 percent afterward. Total increased runoff into Lake Powell during construction would be 0.43 percent, and 2.0 to 2.67 percent after construction. Increased runoff is attributable to access roads and impervious surfaces. Increased quantities of runoff into Wahweap Creek, Warm Creek and Lake Powell would be less than 3 percent, and therefore would not have a significant impact.

FIGURE III-22

Increases in Runoff on Disturbed Areas
When Subjected to a 50-Year, 6-Hour Duration Storm

Site	Acre-Feet of Runoff				
		During construction		After construction	
	Present	Projected	% Change	Projected	% Change
Power plant	8.9	34.10	283.15	42.8	380.90
Water pipe line	15.96	24.44	53.13	18.76	17.54
New highway	10.68	17.90	67.60	34.89	226.68
Coal mine	15.19	37.73	148.39	42.96	182.82
New community	54.08	147.12	175.74	201.60 to 246.40	272.78 to 355.62
Aggregate site and access road	0.41	0.85	107.32	1.11	170.73
Other aggregate sites	1.93	4.01	107.77	5.23	170.98
Total	107.15	268.15	150.25	347.35 to 392.15	224.17 to 265.84

FIGURE III-23

Runoff from 50-Year, 6-Hour Duration Storm for Selected Years, Area of Salt Deposition at Power Plant Site

Selected year	Estimated increase in runoff (acre-feet)	Total runoff [a]	Percent increase over present runoff
5	1.98	35.27	5.95
10	4.03	37.32	12.10
15	4.75	38.04	14.27
20	6.87	40.16	20.64
25	7.65	40.94	22.98
30	9.07	42.36	27.25
35	11.40	44.69	34.24
40	12.82	46.11	38.51
45	15.23	48.52	45.75
50	19.48	52.77	58.52

[a] Present conditions:

Estimated runoff from area of salt deposition . . . . 8.25 acre-feet

Estimated runoff from power plant site after construction. . . 25.04 acre-feet

Total estimated runoff (used as base line for comparison). . . 33.29 acre-feet

FIGURE III-24

Increases in Average Annual Runoff
Using 2-Year, 6-Hour Storm as It Affects Warm Creek and Wahweap Drainage Systems

Site	Drainage Affected	Drainage Area (mi^2)	Present (acre-ft)	Average Annual Flow (acre-feet) During Construction Flow	During Construction % Change	After Construction Flow	After Construction % Change
Power plant	Warm Creek	200	1,000	1,001.84	0.18	1,006.4	0.64
Water pipe line	Warm Creek	200	1,000	1,001.53	0.15	1,000.03	-
	Wahweap Creek	440	2,000	2,000.40	0.02	2,000.79	0.04
New highway	Warm Creek	200	1,000	1,001.02	0.10	1,002.75	0.28
	Wahweap Creek	440	2,000	2,000.86	0.04	2,002.32	0.12
Coal mine and support facilities	Warm Creek	200	1,000	1,002.62	0.26	1,016.04	1.60
New community	Wahweap Creek	440	2,000	2,004.48	0.22	2,030.76 to 2,050.86	1.54 to 2.54
Aggregate site and access road	Wahweap Creek	440	2,000	2,000.04	-	2,000.22	0.01
Other aggregate sites	Wahweap Creek	440	2,000	2,000.14	0.01	2.000.77	0.04
Total effect on Warm Creek		200	1,000	1,007.01	0.70	1,025.22	2.52
Total effect on Wahweap Creek		440	2,000	2,005.92	0.30	2,034.86 to 2,054.96	1.74 to 2.75
Total effect on Lake Powell		640	3,000	3,012.93	0.43	3,060.08 to 3,080.18	2.00 to 2.67

Figure III-25 relates to the Paria River drainage and the possible impact of new highway and aggregate sites. Based on present estimates, runoff into Paria River drainage would not increase appreciably during construction, and only 0.01 percent afterward. As the runoff increase is less than 1 percent, these changes are not considered significant.

Figure III-26 shows increases and decreases of estimated sediment from the impacted sites. During construction, sediment would increase 28.7 percent, and would decrease 7.8 percent afterward. However, this could be misleading, as the borrow areas along roads receive increased amounts of runoff and would be eroding at a faster rate than the area does at present, particularly along the highway segments in Nipple Creek, the head of Tibbets Canyon, Wesses Cove, Pilot Knob, and Wesses Canyon (see Appendix for detailed analysis).

Figure III-27 identifies estimated sediment production projected for selected years from the salt-accumulation area. In 35 years, the annual erosion rate of the power plant site would exceed the present annual erosion rate by 92.5 percent, and increase 100 percent after 50 years because of reduced vegetation on the salt-accumulation area. After 50 years, cumulative sediment production would be 0.86 acre-foot greater than projected at present estimated production rates. The increased sediment rate would also further reduce vegetative productivity in the salt-accumulation area. The amount of this reduction cannot be estimated at this time.

Total effect of sediments on Lake Powell and the Warm Creek and Wahweap Creek drainages during and after construction is presented in Figure III-28. During construction, annual sediment yield would increase 0.57 percent to the Warm Creek drainage, 0.45 percent to the Wahweap Creek drainage and 0.48 percent to Lake Powell. The increase at Lake Powell assumes that all other variables in other portions of the lake remain constant. After construction, sediment would decrease 0.96 percent in the Warm Creek drainage, increase 0.24 percent in the

FIGURE III-25

Increases in Average Annual Runoff
Using 2-Year, 6-Hour Storm as it Affects the Paria Drainage System

Action	Drainage affected	Drainage area (mi^2)	Present (acre-feet)	Average annual flow (acre-feet) During construction		Average annual flow (acre-feet) After construction	
				Flow	% Change	Flow	% Change
New highway	Paria River	1,410	21,600	21,600.63	-	21,601.69	0.01
Other aggregate sites	Paria River	1,410	21,600	21,600.05	-	21,600.26	-
Cumulative effect to Paria River			21,600	21,600.68	-	21,601.95	0.01

FIGURE III-26

Estimated Changes in Annual Sediment Yield
on Disturbed Areas (acre-feet)

Site	Present	During construction		After construction	
		Projected	% Change	Projected	% Change
Power plant	0.84	1.16	+38.09	0.53	-36.90
Water pipe line	0.45	0.50	+11.11	-0.48	+6.67
New highway	0.47	0.56	+19.15	0.52	+10.64
Coal mine and support facilities	1.20	1.47	+22.50	0.31	-74.17
New community	3.50	4.63	+32.29	4.10	+17.14
Aggregate site and access road	0.016	0.022	+37.50	0.019	+18.75
Other aggregate sites	0.08	0.10	+25.00	0.09	+12.50
Total	6.56	8.44	+28.66	6.05	-7.78

FIGURE III-27

Annual Sediment Production for Selected Years
in Area of Salt Deposition at the Power Plant Site
(acre-feet)

Selected year	Estimated sediment increase	Total annual sediment production after construction[a]	Percent change[b]
5	0.03	2.94	83.75
10	0.06	2.97	85.62
15	0.07	2.98	86.25
20	0.10	3.01	88.12
25	0.11	3.02	88.75
30	0.13	3.04	90.00
35	0.17	3.08	92.50
40	0.20	3.11	94.38
45	0.23	3.14	96.25
50	0.29	3.20	100.00

[a] Conditions after the power plant has been built:
Estimated annual sediment production from power plant site 0.53
Estimated present annual sediment production from area of salt deposition 1.07
Total estimated annual sediment production. 1.60

[b] Present conditions
Estimated annual sediment production from proposed power plant site. 0.84
Estimated present annual sediment production from area of salt deposition 1.07
Total estimated annual sediment production. 2.91

FIGURE III-28

Changes in Estimated Annual Sediment Yield
for Warm Creek and Wahweap Drainages (acre-feet)

Site	Drainage affected	Drainage (mi^2)	Present yield	During construction Yield	During construction % Change	After construction Yield	After construction % Change
Power plant	Warm Creek	200	120	120.32	+0.27	119.69	-0.26
Water pipe line	Wahweap Creek	440	265	265.01	-	265.01	-
	Warm Creek	200	120	120.04	+0.03	120.02	+0.02
New highway	Wahweap Creek	440	265	265.02	+0.01	265.01	-
	Warm Creek	200	120	120.05	+0.04	120.03	+0.02
Coal mine and support facilities	Warm Creek	200	120	120.27	+0.22	119.11	-0.74
New community	Wahweap Creek	440	265	266.13	+0.43	265.60	+0.23
Aggregate site and access road	Wahweap Creek	440	265	265.01	-	265.00	-
Other aggregate sites	Wahweap Creek	440	265	265.02	0.01	265.01	-
Total effect on	Warm Creek	200	120	120.68	+0.57	118.85	-0.96
Total effect on	Wahweap Creek	440	265	266.18	+0.45	265.63	+0.24
Total effect on	Lake Powell	640	385	386.86	+0.48	384.48	-0.14

Wahweap Creek drainage, and decrease in Lake Powell by 0.14 percent. Here again, these results do not reflect local problems along access roads and highways. Annual increased and decreased quantities of sediment, during and after construction, are less than 1 percent, when considering the impact on tributary drainages and Lake Powell, and therefore impacts are insignificant.

Amounts of sediment that would be deposited in the Paria River drainage are displayed in Figure III-29. As indicated, these sediment loads are so small as to be negligible, considering the total drainage area affected. Therefore, expected impacts would be insignificant.

Figure III-30 identifies cumulative changes in sediment deposition for selected years after power plant operation begins, and the effects on Wahweap and Warm creek drainages and Lake Powell. In Wahweap Creek there would be a net increase in sediment deposition, and a net decrease in sediment deposition in Warm Creek. However, this decrease does not reflect local problems of highways and roads at the head of Tibbet Canyon, Pilot Knob and Wesses Cove, and roads in Wesses and Missing canyons. Approximately 5 percent of the increased sediment in Wahweap Creek could be attributed to the highway along Nipple Creek, aggregate access road in Upper Wahweap, and lower portions of the water pipe line and its patrol road. The remaining 95 percent of the increase would result from construction of the new community.

It is not known if reduction of sediment in Lake Powell would cause a reduction of nutrients for phytoplankton and phyloplankton, a source of food for fish and other aquatic species. Reduction of sediment would be beneficial for spawning fish.

The above analysis assumes there would be no channel straightening during extraction of aggregates in upper Wahweap, and that drift rate for salt entrained in water from the cooling towers would be 0.01.

FIGURE III-29

Changes in Estimated Annual Sediment Yield
for the Paria Drainage (acre-feet)

Site	Drainage affected	Drainage (mi^2)	Present yield	During construction Yield	During construction % Change	After construction Yield	After construction % Change
New highway	Paria	1,410	846	846.02	-	846.01	-
Other aggregate sites	Paria	-	-	846.000	-	846.00	-
Cumulative effect to Paria River		1,410	846	846.02	-	846.01	-

FIGURE III-30

Changes in Accumulated Sediment Deposition for Selected Years After Power Plant Begins Operation, Compared to Present Estimated Annual Sediment Rates (estimated acre-feet)

Selected year	Salt deposition area	Warm Creek drainage	Wahweap Creek drainage	Lake Powell
5	0.09	- 5.75	3.15	- 2.60
10	0.18	-11.50	6.30	- 5.20
15	0.21	-17.25	9.45	- 7.80
20	0.30	-23.00	12.60	-10.40
25	0.33	-28.75	15.75	-13.00
30	0.38	-34.50	18.90	-15.60
35	0.50	-40.25	22.05	-18.20
40	0.59	-46.00	25.20	-20.80
45	0.68	-51.75	28.35	-23.40
50	0.86	-57.50	31.50	-26.00

Construction of additional evaporation ponds would result in a net decrease in storm runoff and sediment yield in the Warm Creek drainage after construction.

Should channels be straightened along the upper Wahweap, sediment deposition into the Wahweap arm of Lake Powell could increase 2 to 10 times over a multi-year period, with the annual rate accelerating each year.

If the new community is established and the power plant built, additional deterioration in the Warm Creek, Wahweap Creek and Last Chance drainages would result from approximately 40,000 visitor days of off-road vehicle use. This deterioration would be caused by compaction of soils and depletion of vegetative cover, resulting in an increase in annual sediment deposition in Lake Powell, particularly within a 100-mile radius. Greatest sediment deposition would occur in the Warm and Wahweap creek drainages near the new community. Sediment deposition would also occur in the Last Chance Creek drainage. Because of the potentially larger areas that would be affected by recreational activities, sediment deposition in Lake Powell from all three drainages could exceed estimates for the construction phase. Lack of knowledge of which areas would be most affected makes it impossible to quantify potential impact on Lake Powell.

Transmission system impact area

Impacts on soil would occur during the survey, construction, and maintenance stages. Acres disturbed are shown in Figure III-31.

Road building would consist of a bladed, 14-foot path with no sustained grades exceeding 12 percent (12 feet vertical per 100 feet horizontal), and no individual pitch (100 - 200 feet) exceeding 16 percent. Figure III-32 shows acres and miles of new roads to be affected by the proposed transmission system, both permanently and temporarily. Temporary roads would be closed and revegetated after the transmission system would be constructed.

FIGURE III-32

Acreage and Miles of New Roads

	Permanent		Temporary		Total	
	Acres	Miles	Acres	Miles	Acres	Miles
Primary proposal	1,480	870	1,755	1,030	3,235	1,900
Northern Kaiparowits proposal	1,250	735	1,755	1,030	3,005	1,765
Arizona Strip proposal	1,790	1,055	1,755	1,030	3,545	2,085

The two major effects on soil would be compaction and exposure. Compaction would be caused by movement of vehicles and equipment on the roads and at tower sites. Compaction would reduce the water-infiltration rate and increase runoff. Exposure would be caused by removal of vegetation for road clearing and tower site preparation. Exposed soils would be subject to wind and water erosion. The intensity of erosion would vary with surface texture of soils affected. Increased sediment yield would total about 28.5 acre-feet per year for the entire transmission system. This increase amounts to .038 inch of soil loss per year. This sediment would have an unknown impact on the areas where it would be deposited.

FIGURE III-31

Acres of Disturbed and Occupied Land-Transmission System

Proposal by segment	Mileage	New acres occupied perm.	New acres occupied temp.	Total acres disturbed	Average acres disturbed per mile perm.	Average acres disturbed per mile temp.	Average total acres disturbed per mile
#1[a]							
Kaiparowits-Phoenix	299	35	2,775	2,810	.12	9.28	9.40
Kaiparowits-Navajo	47	5	440	445	.11	9.36	9.47
Kaiparowits-Moenkopi-Mohave	308	550	1,385	1,935	1.79	4.50	6.28
Kaiparowits-Eldorado	269	580	1,210	1,790	2.16	4.50	6.65
Mohave-Serrano	534	405	1,560	1,965	.76	2.92	3.68
Total	1,457	1,575	7,370	8,945	1.08[d]	5.06[d]	6.14[d]
#2[b]							
Kaiparowits-Phoenix	299	35	2,775	2,810	.12	9.28	9.40
Kaiparowits-Navajo	47	5	440	445	.11	9.36	9.47
Kaiparowits-Eldorado	269	580	1,210	1,790	2.16	4.50	6.65
Northern Kaiparowits-Mohave	327	325	900	1,225	.99	2.75	3.75
Mohave-Serrano	534	405	1,560	1,965	.76	2.92	3.68
Total	1,476	1,350	6,885	8.235	.92	4.66	5.58
#3[c]							
Kaiparowits-Phoenix	299	35	2,775	2,810	.12	9.28	9.40
Kaiparowits-Navajo	47	5	440	445	.11	9.36	9.47
Arizona Strip-Eldorado	251	580	1,210	1,790	2.36	4.82	7.13
Arizona Strip-Mohave	309	865	2,700	3,565	2.80	8.74	11.54
Mohave-Serrano	534	405	1,560	1,965	.76	2.92	3.68
Total	1,440	1,890	8,685	10,575	1.31	6.03	7.34

(Does not include substations and communications sites)

[a] Primary proposal
[b] Northern Kaiparowits proposal
[c] Arizona Strip proposal
[d] Average for the proposal

Data were calculated from Soil Conservation Service sediment yield maps and tables. This small loss of top soil would result in an unknown but probably minor loss in soil productivity.

The preparation of tower sites, stringing and pulling sites, parking areas, assembly areas and batch plant sites, and road clearing, would change the topography. This would change the pattern of runoff, probably creating drainage patterns through new rills and gullies. This impact would be magnified by compaction of the road surfaces and other disturbed areas. Increased runoff, coupled with increased wind erosion due to soil exposure, would cause increased sediment yield. Erosion increase would be greatest during construction and afterward, until ground cover would be reestablished.

Other potential effects of construction would be the draining of petroleum products on the ground while servicing equipment, discarding of other waste materials, and disposal of excess concrete and other building materials. This would affect soils by sealing the surface and changing drainage patterns, thus increasing erosion and damaging the vegetation. Destruction of vegetation or loss of productivity would have an impact, to an unknown degree, on animals dependent on the plants for food or cover.

Acres of soil units disturbed

Figures III-33, -34, -35, show disturbed acres by soil units crossed by the three proposals. (Mohave-to-Serrano segment is not included due to lack of detailed soil data.)

FIGURE III-33

Soil Acreage Disturbed by
Primary Proposal
(less the Mohave-to-Serrano segment)

Soil unit	Miles	Acres permanent	Occupied temporarily
I	12	13.0	60.7
UU	23	24.8	116.4
II	3	3.2	15.2
LL	7	7.6	35.4
WW	3	3.2	15.2
X	6	6.5	30.4
O	18	19.4	91.1
W	13	14.0	65.8
P	6	6.5	30.4
E	4	4.3	20.2
U	1	1.1	5.1
B	3	3.2	15.2
D	6	6.5	30.4
K	1	1.1	5.1
N	4	4.3	20.2
5A	19	20.5	96.1
4C	110	118.8	556.6
4A	99	106.9	500.9
2A	105	113.4	531.3
1B	19	20.5	96.1
1D	14	15.1	70.8
1A	38	41.0	192.3
10	2	2.2	10.1
8	33	35.6	161.0
7	20	21.6	101.2
11	11	11.9	55.7
4	13	14.0	65.8
13	16	17.3	81.0
40	18	19.4	91.1
3A	11	11.9	55.7
4B	30	32.4	151.8
5	12	13.0	60.7
15	2	2.2	10.1
1	22	23.8	111.3
6	12	13.0	60.7
2	83	89.6	420.0
3	25	27.0	126.5
9	26	28.1	131.6
14	10	2.2	10.1
18	45	48.6	227.7
19	3	3.2	15.2
20	15	16.2	75.9

42 units
923 miles

FIGURE III-34

Soil Acreage Disturbed by
Northern Kaiparowits Proposal
(less the Mohave-to-Serrano segment)

Soil unit	Miles	Acres permanent	Occupied temporarily
I	8	9.4	40.4
UU	22	25.7	111.1
II	2	2.3	10.1
LL	6	7.0	30.3
WW	2	2.3	10.1
X	4	4.7	20.2
O	16	18.8	80.8
W	14	16.4	70.7
P	4	4.7	20.2
E	8	9.4	40.4
U	2	2.3	10.1
B	6	7.0	30.3
D	12	14.0	60.6
K	2	2.3	10.1
N	8	9.4	40.4
5A	12	14.0	60.6
4C	63	73.7	318.2
4A	78	91.3	393.9
2A	61	71.4	308.1
1B	19	22.2	96.0
1D	14	16.4	70.7
1A	32	37.4	161.6
10	2	2.3	10.1
8	27	31.6	136.4
7	20	23.4	101.0
11	11	12.9	55.6
4	11	12.9	55.6
13	16	18.7	80.8
4D	18	21.1	90.9
4B	42	49.1	212.1
1	6	7.0	30.3
2	137	160.4	681.9
9	52	60.8	262.6
14	20	23.4	101.0
18	115	134.6	580.8
19	6	7.0	80.8
20	64	74.9	323.2

37 units
942 miles

FIGURE III-35

Soil Acreage Disturbed by
Arizona Strip Proposal
(less the Mohave-to-Serrano segment)

Soil unit	Miles	Acres permanent	Occupied temporarily
I	8	9.5	41.0
UU	22	26.2	112.6
II	2	3.4	10.2
LL	6	7.1	30.7
WW	2	3.4	10.2
X	4	4.8	20.5
O	16	19.0	81.9
W	14	16.7	71.7
P	4	4.8	20.5
E	8	9.5	41.0
U	2	3.4	10.2
B	6	7.1	30.7
D	12	14.3	61.4
K	2	3.4	10.2
N	8	9.5	41.0
5A	12	14.3	61.4
4C	63	75.0	322.6
4A	78	92.8	399.4
2A	125	148.8	640.0
1B	19	22.6	97.3
1D	14	16.7	71.7
1A	32	38.1	163.8
10	2	3.4	10.2
8	17	20.2	87.0
7	20	23.8	102.4
11	11	13.1	56.3
4	11	13.1	56.3
13	16	19.0	81.9
40	18	21.4	92.2
4B	16	19.0	81.9
15	10	11.9	51.2
2	88	104.7	450.6
9	42	50.0	215.0
18	75	88.3	384.0
19	26	30.9	133.1
20	55	65.5	281.6
21	28	33.3	143.4
16	14	16.7	71.7

38 units
908 miles

Limestone quarry impact area

The limestone quarry would consist of the quarry, a building complex, access roads, powder magazine and limestone stockpile. Figure III-36 shows acreages that would be disturbed during construction of each component and the area permanently occupied after construction. A total of 240 acres would be affected by the limestone quarry operation.

FIGURE III-36

Estimate of Area Affected by the
Proposed Limestone Quarry

	Acres disturbed during construction	Acres permanently occupied
Access road	80	80
Shop and office	5	5
Quarry	130	130
Quarry road	20	20
Magazine and roads limestone stockpile	5	5
Approximate total	240	240

Figure III-37 shows runoff and sediment expected during and after construction. Main considerations in the following analysis are the possible effects of 2-year and 50-year storms of 6-hour duration, and the anticipated sediment yield from the proposed limestone quarry. Analysis was based on the assumption that the participants would file an acceptable mining plan for unpatented mining claims, as required by 36 CFR 252.

The limestone quarry would be in the High Mountain Soil Association, composed of soils frozen during some part of the year. During construction and operation of the limestone quarry, 240 acres or 0.38 square mile would be disturbed and used.

FIGURE III-37

Runoff and Sediment from 2-Year and 50-Year, 6-Hour Storms
at Present, During Construction of the Limestone Quarry, and During Operation
(estimated acre-feet)

Facility	Storm Runoff: Present 2-Year	Present 50-Year	Construction 2-Year	Construction 50-Year	Operation 2-Year	Operation 50-Year	Estimated Annual Sediment: Present	Construction	Operation
Quarry	0	0.43	0.22	3.25	0	0	0.070	0.090	0
Shop and office	0	0.02	0.01	0.12	0.46	0.92	0.004	0.005	0.01
Highway	0	0.26	0.14	2.00	1.36	5.92	0.041	0.058	0.05
Access roads, magazine, and stockpile	0	0.08	0.04	0.63	0.31	1.63	0.015	0.017	0.02
Total	0	0.79	0.41	6.00	2.13	8.47	0.13	0.17	0.08

During construction, runoff from a 2-year, 6-hour storm would increase by 0.41 acre-foot, because of vegetation removal. It would increase another 1.72 acre-feet afterward, due to creation of about 110 acres of relatively impervious surface: shops, offices, highways and access roads, and the powder magazine. However, the quarry itself would have a decrease in runoff during operations as it would trap water.

In a 50-year, 6-hour storm runoff would increase 5.21 acre-feet during construction, and increase another 2.47 acre-feet afterward, for reasons cited above relative to the 2-year, 6-hour storm.

Annual sediment would be increased by an estimated 0.04 acre-foot during construction, due to surface disturbance. During operations, annual sediment yield would be decreased by 0.08 acre-foot, compared to the present, with the quarry acting as a trap, and with the soil-stabilizing effect of offices and shops. However, annual erosion would actually increase along access roads and highways, and the topsoil stockpile.

If soil rehabilitation efforts would be concurrent with the mining operation, reseeding probability would remain more than 7 years out of 10. If rehabilitation would not be concurrent, the probability could decline to 5 to 7 years out of 10. Should rehabilitation be put off until after the mining operation, some 35 to 50 years hence, it is likely that the probability of seeding success would be as low as 3 years out of 10. The longer the topsoil is stockpiled, the more fertility is lowered, due to loss of soil structure. The risk of erosion loss also increases.

Closest reservoir that could be affected by sedimentation is Piute Reservoir, which receives an estimated 124 acre-feet of sediment a year. Probable increase in sediment during construction of the quarry would be insignificant, less than one-third of one-tenth percent. Increased sediment yield during the operational phase is also insignificant, less than one-tenth percent.

WATER RESOURCES

Kaiparowits Plateau impact area

Potential impacts of the proposed project on ground and surface waters will be discussed separately. Because of the close relationship between ground water and surface water, however, any adverse impact on one would eventually affect the other. This is especially true with regard to ground water, which provides base flow to streams and eventually to Lake Powell and the Colorado River. Movement from water-yielding areas to Lake Powell is very complex and because of the scarcity of the data, poorly understood. Until the system is better defined, water monitoring programs and detailed hydrologic studies in the proposed project area are essential. To this end, a comprehensive water quality monitoring program has been implemented by the project participants and participants in the Environmental Protection Agency 208 Waste Water Quality Management Study. The Program is designed to collect baseline data from all water sources including the Warm and Wahweap arms of Lake Powell that could be impacted by the proposed power plant, coal mines, related facilities and smoke stack emissions. The program, which would continue through the life of the proposed project, is subject to approval by the Department of the Interior.

Ground water

Generating station and related facilities

The participants do not propose to use ground water to construct or operate the generating station and related facilities. However, the principal local source of aggregate for construction would be alluvium, which forms a shallow aquifer in upper Wahweap Creek Canyon. About 1,400 acre-feet of this alluvium (mostly in Sections 20 and 21, T.39 S., R.1 E.) would be excavated to obtain the required aggregate. This alluvium is almost completely saturated throughout the year, containing an estimated 200 acre-feet of recoverable ground water in storage. By excavating the alluvium, therefore, the natural recoverable ground water storage capacity of the alluvial aquifer would be reduced by 200 acre-

feet. However, very little of the water would be lost. Most would be ponded in the resulting borrow pit or pumped and released downstream. If water is pumped and released downstream, a discharge permit would have to be obtained from the Environmental Protection Agency. Any water loss during the operation would result from increased evaporation, but would be too small to measure or to affect downstream water users.

The borrow pit would expose local ground water at land surface, thus increasing the potential for contamination. It would also create a safety hazard if unfenced or unguarded, because of the possible use of the ponded water as a swimming hole.

Fourmile Bench, on which the proposed generating station would be built is in an area of natural ground water recharge. By the end of the projected 35-year life of the project, about 932 acres of this area would be occupied for ash disposal, evaporation ponds and other facilities that would impede percolation of rain and melting snow to underlying aquifers, thus reducing natural ground water recharge. Such recharge on this 932-acre area is estimated to be about 34 acre-feet per year. Consequently the proposed project would reduce natural ground water recharge in the Kaiparowits Plateau impact area by about 34 acre-feet per year or about 0.1 percent. The ultimate effect of this reduction would be an approximately equal reduction of local, natural ground-water discharge. Apportioned over the areas of natural discharge (most likely the bottoms of canyons leading from Fourmile Bench), the decreased discharge would be too small to measure or to effect local ground water users, including wildlife, livestock, and salt cedar.

It is unlikely that the principal Navajo Sandstone aquifers would be contaminated by leakage from facilities such as the evaporation ponds or ash disposal sites since the aquifers in this area are overlain by several thousand feet of relatively impermeable strata. Any contaminants that might seep into the subsurface would most likely appear in seeps and springs in the nearby deeply incised canyons before circulating all the way down to the Navajo Sandstone.

However, the water in local shallow perched aquifers beneath the proposed plant site could be contaminated by the downward seepage of these contaminants.

Evaporation ponds would occupy up to 180 acres in the Warm Creek drainage basin during the projected 35-year life of the project and for an indefinite period afterwards. The ponds would receive about 260 gallons per minute (gal/min) (about 420 acre-feet per year) of cooling tower blowdown water, with a dissolved-solids concentration of about 7,500 milligrams per liter (mg/ℓ). They would also receive other mineralized fluid wastes, including about 95 acre-feet per year of effluent from the demineralizer. Dissolved solids in the ponds would be greatly concentrated by evaporation, and would exceed 15,000 mg/ℓ after only 50 percent evaporation. This is 25 times the dissolved solids concentration in local ground water. Leakage of water with a dissolved solids concentration of 15,000 mg/ℓ and mixing it with an equal amount of ground water, would increase the dissolved-solids concentration of the ground water to nearly 8,000 mg/ℓ, making the water marginal to unsuitable for livestock and wildlife who now use the water. Although the water is not currently used by humans, such contamination would make it unsuitable for human consumption in the future.

Without the use of an impervious liner in the evaporation ponds, the saline water could readily seep into the relatively permeable sandstone strata on which the ponds would be constructed, and could eventually enter underlying aquifers or nearby streams. Data collected by the participants from a 297-foot deep, 4-inch diameter exploratory well at the site of the proposed evaporation ponds show that the shallowest ground water in the area was located at a depth of about 167 feet. Laboratory analysis of 6-inch long core samples collected from the well indicate that the penetrated rock strata have the following coefficients of permeability:

Depth in feet	Coefficient of Permeability (feet per year)
0 - 16	483.20
16 - 47	6.62
47 - 94	3.34
94 - 164	80.79
164 - 250	0.34

These coefficients may not be representative of the entire rock section beneath the 180-acre area of the proposed evaporation ponds. Actual field coefficents may be lower in some locations because of tighter rock cementation or finer-grained rock facies; they may be higher at other localities due to looser cementation, coarser-grained rock facies or open rock fractures. The relatively high coefficient of permeability shown for the upper 16 feet penetrated by the exploratory well may be due in part to weathering which would be uniform over the entire area of the proposed ponds. In this case, the upper 16 feet of rocks over the entire area would have relatively high permeability. Once saline water has seeped into and saturated the shallow permeable rock beneath the evaporation ponds, it could then migrate laterally along the top of less-permeable strata and appear as saline seeps in nearby canyons, or it could continue downward along fractures to the underlying aquifers. In either case, it would eventually enter the surface drainage.

The potential for contaminating local ground water or streams would persist long after the projected 35-year life of the proposed project. The evaporation ponds would have accumulated at least 160,000 tons of salt during the 35 years. The presence of such a large stockpile of salt near the head of Warm Creek would be a source of contaminants that could effect the ecosystem in the Warm Creek Bay of Lake Powell for an indefinite period of time.

The ash disposal area would occupy up to 450 acres near the head of Warm Creek, and would receive up to 50 million cubic yards of fly ash, bottom ash, scrubber sludge and other solid wastes during the projected 35-year life of the project. It would contain large concentrations of such trace elements as arsenic, barium, boron, fluorine, selenium, titanium and vanadium (see the soils section of this chapter). A layer of mudstone, approximately 80-feet thick reported by the participants to have a permeability cooefficient of .05 feet a year, directly underlies the proposed disposal area. This mudstone would virtually eliminate the potential for contaminating ground water in underlying aquifers during the projected life of the project. Over a long term some of those elements could eventually reach aquifers, but data are not available to determine if this would lead to toxic concentrations in the ground water.

Storage of 300,000 barrels of fuel oil on the proposed generating station site would create a potential for a major oil spill (such as rupture of a storage tank) in the Warm Creek drainage basin. However, the chance of such a spill seriously contaminating local water sources or reaching Lake Powell would be remote (provided containment and clean up are effective). Some oil from such a spill would seep into the sandstone under the storage tanks, where it could not be completely removed. This sandstone has an estimated effective porosity of less than 2 percent. Therefore, it would retain at least 98 percent of the absorbed oil. The rest would be released into the hydrologic system in small quantities over a long period and would not adversely affect local water sources or the water in Lake Powell.

The 65-acre (2,350 acre-foot capacity) reservoir at the proposed generating station site would contain water of better quality than the underlying ground water. Leakage from this reservoir would not adversely affect ground water quality. Any large amount of leakage could form a small, shallow, perched ground water body which could discharge as seeps along nearby canyon walls. The participants estimate that total leakage from the reservoir would be about 300 acre-feet a year.

Coal mine and related facilities

The regional ground water table and principal aquifers in the Navajo Sandstone lie more than 500 feet beneath the lowest coal-bearing beds that would be mined, and appear to have no hydraulic connection with the beds. Therefore, ground water in the main zone of saturation and the principal aquifers would not be affected by mining or subsequent subsidence.

Core-drilling data from the coal lease area reveal the presence of discontinuous, perched aquifers with fresh to slightly saline water in and above the coal-bearing beds that would be mined. These aquifers and the water in them would be affected, at least locally, by mining and subsequent subsidence. Effects would be negligible during the early years of mining. The maximum effect would not be felt until after the projected 35-year life of the project. By this time mine-drainage activities would dewater aquifers intersected by the mines. Subsequent subsidence would fracture overlying rock, creating channels between fresh- and saline-water aquifers and thereby degrade ground water quality. Also, ground water gradients would be altered so that water which discharged naturally at a given spring might discharge elsewhere.

Information about the location, extent, and hydrologic properties of the perched aquifers and their water quality is too meager to predict impacts on particular springs or to accurately evaluate such impacts. The maximum overall effect is roughly predictable from the sparse available data and some field observations. After field observations in late May, 1974, when there was no overland runoff from storms or melting snow, ground water discharge in Warm and Last Chance creeks draining perched aquifers in the coal lease area was estimated at about 50 gal/min. Probably another 50 gal/min. of ground water was discharging through the subsurface to stream valley alluvium, to be lost through evapotranspiration. Therefore, total ground water discharge from perched aquifers affected by coal mining and subsequent subsidence is estimated at 100 gal/min, or

160 acre-feet per year. Assuming that this water is eventually diverted by mining, natural ground water discharge in the Kaiparowits Plateau impact area would be reduced by about 0.53 percent.

Water produced at the mines would be consumed in various mining activities and would not be returned to the ground water system or released to streams. This would result in depletion of a number of seeps and springs in lower Warm Creek and possibly Last Chance creek-currently sources of drinking water for livestock and wildlife. As a result, livestock grazing would be reduced by several hundred acres unless water were hauled to the area. A number of small birds and mammals now using these water sources would be displaced to other parts of the Kaiparowits Plateau, or eliminated.

Ground water in the coal lease area is tributary to Lake Powell. The average salt concentration of this ground water is considerably greater than that of Lake Powell. Therefore, diversion of this water so that it does not reach Lake Powell would have a slight beneficial impact on the Lake and Colorado River with respect to water quality.

No ground water would be lost by subsidence resulting from mining. However, the ground water system and discharge would be changed. For example, an aquifer currently discharging in a single spring used by livestock and wildlife might discharge over a larger area by diffuse seepage, as a result of subsidence. This would eliminate a waterhole for livestock and wildlife, even though the water supply was not depleted. Creation of channels between fresh- and saline-water aquifers, as a result of subsidence, would deteriorate the quality of the fresh-water aquifer. This deterioration would not make the water in that aquifer unsuitable for livestock and wildlife, because of their relatively-high tolerance for moderately saline water. However, it probably would make the water unsuitable for human consumption.

Tailings from the coal washing and handling facilities would be slurried to a tailings pond near the head of Warm Creek occupying up to 550 acres after the projected 35-year life of the project. Tailings would carry concentrations

of such trace elements as arsenic (1 part per million (ppm) ± 10 ppm), fluorine (765 ppm ± 260 ppm), boron (31 ppm ± 5 ppm), nickel (21 ppm ± 6 ppm), and chromium (67 ppm ± 48 ppm) in excess of concentrations found in ground water. Consequently, any leakage from the tailings pond to underlying aquifers would raise concentrations of those trace elements in the ground water. Because of their relatively low solubility, and a tendency for many of these elements to be absorbed by fine-grained shale and mudstone (through which they would have to move in the ground water system), they probably would not significantly increase present concentrations at points of ground water discharge. Very little is known, however, about natural concentrations of those elements in the local ground water or how they move through the ground water system. Therefore, significant trace elements are being monitored in the water-quality monitering program for the project.

The course refuse dump would occupy up to 550 acres adjacent to the tailings pond. It would contain mostly coal and country rock (the kind of rock through which ground water flows naturally). Therefore, any water percolating through this dump to underlying ground water would have a negligible effect on ground water quality.

The sewage lagoon in the coal mine area would contain treated sewage. Should there be any leakage of effluent to the ground water, fine-grained rocks through which the effluent must percolate would filter and purify the effluent before it reached the ground water. There is a slight possibility that fractures would readily convey some of the effluent to local springs. The pollution of springs by this effluent would be no worse than the present pollution of springs by organic waste from livestock and wildlife.

New town

The anticipated source of water for the proposed Kaiparowits new town is the ground water reservior beneath East Clark Bench. Deep large-diameter wells

would be required to obtain the water. These wells would probably tap aquifers in the Navajo Sandstone, already tapped by several other wells in the Glen Canyon City area.

According to Kaiser Engineers (1975), preliminary studies indicate that six wells, each yielding 1,000 gal/min. would be required to supply the proposed new town. Continuous pumping of all six wells would result in a total annual ground water withdrawal of about 9,690 acre-feet (nearly 20 times the 1974 estimated annual rate of ground water withdrawal by wells in the Glen Canyon City area). This withdrawal rate may exceed the annual natural rate of ground water recharge to the aquifers.

Any artificial withdrawal of ground water eventually leads to a proportionate decrease in natural discharge from the ground water system. Most ground water in the East Clark Bench area discharges naturally to lower Wahweap Creek, and the Wahweap Creek arm of Lake Powell. Consequently, pumping of water at an annual rate of 9,690 acre-feet would reduce natural inflow to Lake Powell by about the same amount, and make the water unavailable for downstream uses.

A large cone of depression (decline of local ground water levels) can be anticipated during pumping of the proposed new town supply wells. This would lower water levels in existing nearby wells resulting in conflicts with existing ground water rights. Such conflicts have occurred in many parts of Utah where applications have been filed to divert large quantities of ground water from previously-appropriated sources.

Because of the large quantity of water that has seeped into the Navajo Sandstone from Lake Powell, application to appropriate the 9,690 acre-feet of water per year from that formation in such close proximity to Lake Powell would also lead to conflict with existing water rights. If an application were to be filed, litigation could be required to determine whether all or part of the water is actually Colorado River water to be included as storage under the jurisdiction of

Utah and the United States. If so a service contract with the Bureau of Reclamation would be required to appropriate the water.

Plans are not complete for the wastewater collection, treatment and disposal system for the proposed new town. The system probably would be built in stages as the proposed town grows. According to Kaiser Engineers (1975), the system would have to handle about 100 gallons per day per capita with commercial flow equal to about 1.5 milligrams per day by the 10th year of growth.

Two of the three systems under consideration would reclaim recycled wastewater for irrigation in which case the required oxidation lagoons would occupy 27 acres. The other system is being considered for the town if irrigation is deemed unnecessary; this system would require 172 acres of oxidation lagoons (considering no overflows).

Regardless of the system used, all or most of it would be built on permeable sandstone which could provide hydraulic connection to underlying aquifers. These are the same aquifers that are tapped by existing wells in the area, and that would be tapped by the proposed new town supply wells. Therefore, leakage from broken collector mains or from the oxidation lagoons could enter those aquifers and create a health problem for the local water users. If unfractured, the sandstone would act as a filter, but fractures exist locally in this sandstone through which wastewater could pass unfiltered to underlying aquifers.

A final proposal has not been submitted for the disposal of solid waste generated by the proposed new town. An earlier proposal submitted by Call Engineering Inc. (1974) indicated that a 200-acre waste disposal area would be required, possibly located to the west of the proposed new town.

Disposal of solid waste in an area west of the proposed new town would be upgradient with respect to movement of ground water toward the proposed new town and Glen Canyon City. Consequently, any contaminants seeping from the

waste disposal area to underlying aquifers would move in the ground water toward existing wells in the Glen Canyon City area (and possibly toward the proposed new town supply wells) adding to the potential health hazard that could be created by the wastewater collection and treatment system.

New highway

An estimated 300 acre-feet of water would be required for construction of the new highway. Additional water may be required for construction of access roads associated with the proposed project. Available local sources of water along the alignments of the proposed highway and other roads include springs in the canyons of Wahweap, Fourmile, Tommy Smith and Cottonwood creeks, or aquifers in the alluvium deposited by those streams. If the water from these sources were to be used for construction of the new highway and other roads, the water (especially from smaller springs) would temporarily be unavailable for their present uses, that is, watering sites for wildlife and livestock.

Nearby towns

The towns of Tropic, Cannonville and Henrieville could experience population increases as a result of the proposed project. These population increases with increased water needs cannot be predicted with any degree of accuracy. Within 10 years of the start of the proposed project, it is estimated the population of Garfield County could increase by about 19 percent. If all three towns were increased by this same percentage, their water needs would be increased by the following amounts in acre-feet per year: Tropic (21.3), Cannonville (6.1), Henrieville (6.5). The current water needs of these towns are met from ground water sources; any increased water supplies would come from the same source, making this ground water unavailable for other uses.

Increased population in the nearby towns would also increase the amount of fluid waste generated in those towns. The Utah Division of Health estimates that the per capita daily production of fluid waste is on the order of 100 gallons.

A wastewater treatment facility planned for the town of Tropic would have the capacity to handle increased fluid wastes generated by the anticipated population increase. Disposal of fluid wastes in the other nearby towns is generally by use of individaul septic tanks. For the immediate future it is assumed the number of such fluid-waste disposal systems would increase in porportion to the anticipated increase in population. The capacity for additional septic tank sewage systems in those towns has not been evaluated.

Surface water

Essentially all water required for construction and operation of the proposed project would be pumped from Lake Powell. A water service contract dated October 2, 1969 exists among the United States, Resources Company, Associated Southern Investment Company and the New Albion Resources Company. It provides for water service from the United States to other named contracting parties on an increasing basis that would result in a total annual use of 102,000 acre-feet from Lake Powell by the year 1989. A total of 2,500 acre-feet of Lake Powell water would be used for construction of the generating station, coal mines, and related facilities. An estimated 50,000 acre-feet per year would be used to operate the proposed project (including mines) at a generating capacity of 3,000 megawatts. None of the water would be released to streams or returned to Lake Powell.

Based on the Bureau of Reclamation estimate of 5.8 million acre-feet per year of Colorado River water available to the upper basin states, Utah's share would not be more than 1.32 million acre-feet per year. Withdrawal and depletion of 50,000 acre-feet per year from Lake Powell would reduce this share by 3.8 percent. Depletions of Colorado River water in Utah at the 1974 level of development are estimated to be about 825,000 acre-feet per year. Therefore, Utah's remaining share of Colorado River water (based on the Bureau of Reclamation estimate of 1.32 million acre-feet total available supply would be about 495,000 acre-feet per year. Withdrawal of 50,000 acre-feet per year

from Lake Powell would decrease Utah's remaining share of Colorado River water by about 10 percent. The withdrawn water would not be available for other uses.

Withdrawal of 50,000 acre-feet per year of water from Lake Powell would also remove a large amount of salt from the Colorado River, resulting in a negative salt-loading effect. However, because the water flow would be reduced, there would also be a salt-concentrating effect on the river, that is, a concentration of the downstream salt load into reduced volumes of river flow. The net effect would be an increase in salinity in the Lower Colorado River adding to the existing Colorado River salinity problem. According to estimates of the U.S. Bureau of Reclamation, withdrawal and depletion of 50,000 acre-feet per year of water from Lake Powell for the proposed project would increase the salinity of the Colorado River at Imperial Dam in the lower basin by 2.0 milligrams per liter (mg/ℓ) as shown in the following table:

Depletion (acre-feet per year)	Salt-loading Effect (mg/ℓ)	Salt-concentration Effect (mg/ℓ)	Combined Salt-loading and Salt-concentration Effect (mg/ℓ)
50,000	-3.0	+5.0	+2.0

These estimates are based on the following conditions: Completion of all federal and other projects (including the Central Arizona Project) under construction except Navajo Indian Irrigation project (which was included at 30 percent completion. These estimates also assume the average concentration of dissolved solids in Lake Powell near the pumping plant to be 550 mg/ℓ. Considering the depth of the proposed pump intake, the average concentration of the water withdrawn may be somewhat higher than 550 mg/ℓ in which case there would be a somewhat smaller effect of the proposed project on Colorado River salinity. However, the effect could be somewhat greater when the project would be operating at full capacity because of greater total depletions and greater salinity in the river system resulting from other new water-use projects. Increased salinity in the Colorado River has and will continue to have

significant economic impact on the river basin, especially to Lower Colorado River water users. For example, Kleinman et al. (1974) indicate that for each mg/ℓ increase in salinity in the lower basin, an annual damage of $230,000 could incur as expressed in terms of agricultural, municipal and industrial uses.

It should be noted, however, that the Colorado River Basin Salinity Control Act of 1974, Public Law 93-320 recognizes salinity of the Colorado River as a basin-wide problem that must be alleviated so that developments using Compact-allocated water can continue while salinity in the river is being controlled. The act authorizes and directs the Secretary of the Interior to proceed with a basin-wide program - The Colorado River Water Quality Improvement Program - for enhancement and protection of the quality of Colorado River water with works or facilities both upstream and downstream from Imperial Dam. The program is under the direction of the U.S. Bureau of Reclamation, and is funded almost entirely by federal funds and revenue from hydroelectric power generation.

The Bureau of Reclamation (1974) estimates that without quality-control projects, the dissolved solids concentration of the rivers at Imperial Dam would average 1,160 mg/ℓ by the year 2000, and that with all possible control projects it would average about 865 mg/ℓ. Therefore, increases in salinity resulting from the proposed project would be offset to some extent by the Colorado River Water Quality Improvement Program.

Generating station and related facilities

Mean annual runoff from that part of Fourmile Bench that would be affected by the proposed generating station and related facilities is estimated at 380 acre-feet or about 6.3 percent of the estimated total mean annual runoff from the Kaiparowits Plateau impact area. Essentially all of this runoff enters Warm Creek. During construction, annual runoff from Fourmile Bench would increase

by an estimated 0.48 percent from vegetation removal, disturbance of soils, and slope modifications. After construction, mean annual runoff would increase by about 1.7 percent in spite of the existence of such runoff-retaining facilities as the evaporation ponds, disposal area, and runoff-retention dam. During construction, total annual sediment yields in the 1,170-acre area that would be disturbed on Fourmile Bench would increase from an estimated 0.84 acre-foot to an estimated 1.16 acre-feet. After construction, total annual sediment yield in this same area would decrease to an estimated 0.53 acre-foot. Essentially all of the increased sediment yield would flow to Warm Creek, but the impact on the ecosystem in Lake Powell would be negligible.

The 450-acre ash disposal area would be at the head of Wesses Canyon in the Warm Creek drainage. As noted in the soils section of this chapter, the mixture of fly ash, bottom ash, and scrubber sludge would contain large concentrations of trace elements (see Figure III-18 in soils section). As noted under the ground water section of this chapter, the ash disposal area would be underlain by poorly permeable mudstone which would impede downward movement of fluids from the disposal area to underlying aquifers. However, there is a possibility that any fluids originating in, or percolating through the disposal area could migrate laterally along the top of the mudstone layer, emerge as seeps along the walls of Wesses Canyon and eventually be washed into Lake Powell's Warm Creek Bay. These fluids would contain some dissolved trace elements. Because of low solubility of the ash-scrubber sludge mixture (about 0.209 grams per cubic centimeter), and even lower solubilities of trace elements, concentrations of these substances in any water moving through the ash disposal area would be near or only slightly greater than concentrations found in natural ground waters. Those concentrations would be further reduced as the elements are carried to Lake Powell by overland runoff.

A long-term environmental problem would be the continued existence of the ash-disposal area at the head of a major drainage to Lake Powell after the projected 35-year life of the proposed project. The degree of success of rehabilitation and reseeding of this area as proposed by the participants has been discussed in the Soils Section of this chapter. The area is prone to flash flooding with accompanying rapid erosion throughout the summer months. Without maintenance of water-controlling structures, erosion would increase after the plant is abandoned. There would be little incentive for industry to maintain these structures after the economic plant life has expired. Therefore, it seems reasonable to assume that without continued maintenance of the ash-disposal area after abandonment of the proposed project, erosion of the deposit would begin and continue at an accelerated rate over the years. Although the material in the disposal area reportedly would set-up like plaster of Paris, making it resistant t short-term erosion, there is no indication that over the long term it would not break down by chemical and mechanical weathering (freezing and thawing) to the point that flash floods could wash it out in the form of mud-rock flows common to this area. This could result in periodic surges of sediment and chemical contaminants into the Warm Creek arm of Lake Powell and subsequent adverse effects on aquatic life. Existence of evaporation ponds in Warm Creek drainage long after the economic life of the proposed project presents a similar potential problem. Should the dikes be left unmaintained, they would eventually be breached by erosion. Subsequent cloudburst flooding could then carry large quantities of the estimated 160,000 tons of accumulated salts to Lake Powell. These would be salts that were formerly in the lake, but their return to the lake could be in concentrated surges into Warm Creek Bay. This could upset the chemical balance to which the aquatic species are adjusted and thus adversely effect those species. And, both the chemical contaminants and salt would decrease the quality of water available for downstream users for as long as the deposits exist in the watershed.

Some salts deposited by cooling tower drift would eventually enter streams and be carried to Lake Powell. Annual deposition of these salts would range from about 250 pounds per acre within 0.4 mile of the towers to less than 4 pounds per acre beyond 3.3 miles from the towers. Total deposition within Wahweap and Warm creek drainages (excluding those areas such as the ash disposal area which would retain runoff) would be about 230 tons per year. It is assumed that about 5 percent or 11 tons of this salt would be taken up and carried to Lake Powell by annual overland runoff. Perhaps 90 percent would enter the Warm Creek arm and the remainder would enter the Wahweap arm. Distributed over a year's time and diluted by the mean annual runoff (about 3,000 acre-feet), the concentrations entering the two arms of the lake would be too small to measure or to affect aquatic life. Large quantities of salt are deposited by evaporating ground water along the bottoms of Wahweap and Warm creeks. Salt runoff from cooling tower drift, when added to natural salt runoff (at least 1,000 tons a year), would be negligible and, therefore, should not affect aquatic life in Warm or Wahweap bays of Lake Powell any more than the natural salt runoff. The effect of the cooling tower drift on vegetation would, however, effect runoff, as noted in the soils section of this chapter.

Stack emissions from the proposed generating station would contain small concentrations of such trace elements as arsenic, mercury, lead and titanium (see air quality section of this chapter) that would eventually enter the hydrologic system - mostly in the Warm and Last Chance creek drainages. Estimated concentrations of most trace elements that would be emitted by the proposed generating station would not exceed natural concentrations (arithmetic means of annual arithmetic means concentrations) measured at Page, Arizona during the period 1969 through 1972. Therefore, the effect of those elements on water resources of the area should be negligible. However, there are insufficient data from which to determine how these elements would enter, concentrate and move through the hydrologic

system or how they would effect the ecosystem. Arsenic, mercury and titanium would apparently be emitted in larger concentration than natural levels measured at Page, Arizona. Deposition of mercury on drainage basins immediately tributary to Lake Powell would increase the amount of mercury available for mercury bioamplification in the lake. This would effect the lakes ecosystem and sport fishing industry.

The water storage reservoir near the proposed generating station poses potential for flooding in Warm Creek. The total storage in the reservoir would be more than twice the estimated mean annual runoff in Warm Creek. Failure of the retaining dike with the reservoir filled to capacity could cause a flood that would exceed any recorded flood peak in the Kaiparowits Plateau impact area.

Coal mine and related facilities

An estimated 500 acre-feet of water would be required for construction of the coal mines and related facilities. About 3,100 acre-feet per year would be required for the mining operations. All of this water would come from the 50,000 acre-feet per year that would be withdrawn for the power project. The potential impacts of withdrawing this water, and the supply and quality of water in the Colorado River were discussed earlier in this section.

Mean annual runoff from areas that would be affected by the coal mines and related facilities (including the proposed Utah Power & Light Company power line) is estimated at 125 acre-feet or about 2 percent of estimated total mean annual runoff from the Kaiparowits Plateau impact area. The area that would be affected by the coal mines and related facilities drains to Warm Creek. During construction estimated annual runoff in Warm Creek would increase by 0.26 percent or 2.62 acre-feet due to removal of vegetation and disturbance of soil. By the end of the projected 35-year life of the proposed project, mean annual runoff in Warm Creek would increase by an estimated 1.60 percent or 16.04 acre-feet even though the tailings pond, clear water pond and other facilities would retain some runoff. Considering that total mean annual runoff in Warm Creek is about 1,000 acre-

feet, and that runoff apparently varies considerably from year to year, impacts of small changes in runoff that would result from mining operations would be insignificant.

Land subsidence from mining out 420 million tons of coal during the projected 35-year life of the proposed project either would alter surface drainage patterns or would accelerate headcut erosion of existing streams. It seems most probable that headcut erosion would be accelerated with little significant change in natural runoff from the area. Even if drainage patterns were changed, causing runoff to flow to the lowest part of the subsiding area, fracturing would probably allow the water to seep into the ground and move toward Warm or Last Chance creeks through the ground water system so that total runoff would not be significantly reduced.

Annual sediment yields in the area that would be disturbed by the coal mines and related facilities would increase from an estimated 1.20 acre-feet to about 1.47 acre-feet during construction, but would decrease to about 0.31 acre-foot after construction. Total sediment yield in the Warm Creek drainage is about 100 acre-feet per year. Therefore a short-term increase of 0.27 acre-foot probably would have a negligible effect on Lake Powell. The longer-term decrease of 1.16 acre-feet would result in a slight reduction of nutrients for aquatic life in the lake, but would tend to lengthen the lake life with respect to sedimentation.

The contents of the tailings pond associated with the coal mine were discussed in the ground water section of this chapter. Proper maintenance of dikes and retention structures around the pond would prevent those tailings from entering Warm Creek in large harmful surges such as during a cloudburst flood. Presumably tailings would remain moist during the project life to prevent them being wind-borne to adjacent unretained drainages. After the projected 35-year life of the proposed project, however, there is no indication that the pond would be maintained. Consequently, as discussed earlier with regard to the

evaporation ponds and ash disposal area associated with the proposed generating station, weathering, erosion, and other natural or man-made forces would breech the dikes; cloudburst flooding would carry large quantities of tailings (with concentrations of pyritic sulfur and trace elements) into the Warm Creek arm of Lake Powell. The trace elements could be toxic to some aquatic life. If concentrated in an anaerobic zone, the pyritic sulfur could affect the ph values of the lake water which, in turn, could affect aquatic life.

New town

Mean annual runoff from the area that would be disturbed by the proposed new town is estimated at about 255 acre-feet, all of which flows into Wahweap Creek. This is about 12.7 percent of total estimated mean annual runoff in the Wahweap Creek drainage. Removal of vegetation, grading and disturbance of soils during construction could increase annual runoff from the area by an estimated 4.48 acre-feet. This would be an increase of runoff from Wahweap Creek to Lake Powell of only about 0.22 percent which would have a negligible effect on the lake. The existence of streets, sidewalks, and storm-drainage systems in the proposed new town could increase mean annual runoff from the area by as much as 50.86 acre-feet and increase inflow to Lake Powell from Wahweap Creek by about 2.5 percent to more than 2,050 acre-feet per year. Although this would be a signific increase on an annual basis, runoff from individual storms would be within the range of past and possible future cloudburst flood runoffs. For example, records collected by the U.S. Geological Survey in Coyote Creek just north of the proposed new town site show peak floods exceeding 4,000 cubic-feet per second (± 300 acre-feet per hour). Any effects on Lake Powell and aquatic life in Wahweap arm of the lake as a result of increased runoff from the proposed new town would be masked by the large amount of storm runoff from adjacent areas.

Exact sitings for the wastewater treatment plant and solid waste disposal area for the proposed new town have not been determined. Presumably, these facilities would be sited to avoid flood-prone areas. Should one or the other

be placed in one of the draws that pass through the East Clark Bench area, it would be washed out by flash floods, and contaminants could be carried to Lake Powell.

New highway and access roads

Mean annual runoff from the 405-acre area that would be disturbed by the new highway and access roads is estimated at 115 acre-feet. Approximately 10 percent of this runoff flows to Cottonwood Creek and the Paria River; the remainder goes to Wahweap and Warm creeks. Reduced vegetation, pavement, and drainage systems associated with the new highway and access roads would increase annual runoff from these areas by at least 1.88 acre-feet (an increase of 1.6 percent). This would be an increase of about 0.18 acre-feet per year in Cottonwood Creek and the Paria River, which is less than 0.001 percent of the average annual gauged runoff near the mouth of the Paria River. The combined increased runoff in Wahweap and Warm creeks would be about 1.69 acre-feet per year or about 0.06 percent of the combined estimated mean annual runoff in those two streams. Any effects of these small increases would be too small to predict or evaluate.

Annual sediment yields in areas disturbed by the new highway and access roads would increase from about 0.47 acre-foot to about 0.56 acre-foot during construction, and would be about 0.52 acre-foot after construction. Proportioned among the streams mentioned in the preceding paragraph, these small changes in sediment yields would be negligible.

Water pipe line and related facilities

Mean annual runoff from areas that would be disturbed by the water pipe line and related facilities is estimated at about 35 acre-feet. Essentially all of this runoff enters Warm Creek. During the short-term construction period, annual runoff from this area would increase by 1.93 acre-feet. After construction it would be increased by only 0.82 acre-feet, chiefly due to hard-surfaced roads and

drainage systems that would be associated with the pipe line. An increase of 0.82 acre-foot per year in runoff from the disturbed area would result in a 0.08 percent increase in runoff at the mouth of Warm Creek. The effects of this increase, if any, would be too small to evaluate.

Annual sediment yields in the area that would be disturbed by the water pipe line and related facilities would increase from about 0.45 acre-foot prior to construction to about 0.50 acre-foot during construction, and would be about 0.48 acre-foot after construction. The post-construction increase would increase sediment yield for the Warm Creek drainage by about 0.46 percent.

Summary of impacts

A total of 59,690 acre-feet per year of water would be used by the proposed project during its projected 35-year life. An estimated 50,000 acre-feet would be withdrawn from Lake Powell, reducing Utah's remaining allotment of Colorado River water by about 10 percent and making the water unavailable for other uses. Applications would be filed to appropriate about 9,690 acre-feet per year of ground water from local aquifers near Lake Powell for the proposed new town. This could lead to litigation to determine if all or part of the water applied for is Lake Powell water in bank storage, thus requiring a water service contract with the Bureau of Reclamation. Withdrawal of the 9,690 acre-feet per year would reduce natural inflow of ground water to Lake Powell by nearly the same amount, and would also conflict with existing ground water rights in the Glen Canyon City area.

Withdrawal of 50,000 acre-feet per year of water from Lake Powell would have a net salt-concentrating effect on the Colorado River compounding the existing Colorado River salinity problem. Based on estimates of the U.S. Bureau of Reclamation, withdrawal and depletion of 50,000 acre-feet per year from Lake Powell would increase the salinity of the Colorado River at Imperial Dam by an

estimated 2.0 mg/ℓ. It has been estimated that for each mg/ℓ increase in salinity in the lower basin, an annual damage of $230,000 could occur as expressed in terms of agricultural, municipal and industrial use. Projects completed under the Colorado River Water Quality Improvement Program would offset to some degree the increased salinity in the river resulting from the proposed project. Coal mining would result in depletions of relatively poor-quality ground water that flows to Lake Powell which would also offset slightly the project-related salinity increases in the Colorado River.

Removal of 420 million tons of coal during the projected 35-year amortized life of the proposed project, and subsequent land subsidence in the mined-out area, would disrupt perched aquifers and probably deplete the flow of some seeps and springs that provide water for livestock and wildlife. Fracturing of rocks by mining and subsidence would create connecting flows between fresh and saline-water aquifers, thus generally deteriorating local ground water quality.

The proposed project would increase long-term mean annual runoff from the Kaiparowits Plateau impact area to Lake Powell and the Colorado River by a maximum of 80 acre-feet. This would be an increase of about 1.33 percent over the estimated mean annual runoff from the Kaiparowits Plateau impact area, but the effect on long-term average annual gauged runoff in the Colorado River at Lee's Ferry, Arizona, would be negligible.

Long-term sediment yields from the Kaiparowits Plateau impact area to Lake Powell and the Colorado River would decrease by about 0.50 acre-foot per year as a result of the proposed project. This would be negligible considering that average annual sediment inflow to Lake Powell is about 91,000 acre-feet.

The combined effect of the proposed project on existing water uses in the area would be the possible conflicts with existing water rights associated with the proposed new town supply. The anticipated influx of population in the

general area could require expansion of existing local town water supplies by about 34 acre-feet a year, and wastewater treatment facilities proportionately. The principal use of ground water within the Kaiparowits Plateau impact area is for livestock and wildlife. Depletion of local springs by the mines or contamination of a spring by leakage from the evaporation ponds would displace some wildlife or livestock. These effects would be negligible compared to other impacts on those resources from the large influx of people and increased accessibility to the area. However, the existence of such facilities as the ash disposal area, mine tailings pond and evaporation ponds near the head of Warm Creek long after the projected 35-year life of the proposed project would be a long-term source of contaminants that could effect the quality of water in local springs, Lake Powell and the Colorado River.

Transmission system impact area

Potential impacts that could result from construction of the transmission system are alteration of spring flows, depletion of ground water supplies, increased sediment load in perennial streams, and pollution of streams.

Specific springs or seeps that might be affected by construction activities cannot be identified because their locations are not known. If a tower were built directly over a spring or seep, or an access road constructed through one, flow rate could be altered.

Construction of the transmission line system would create a temporary demand for water. The water which would be used for mixing concrete and dust control would come from ground and surface water supplies. The applicants anticipate using about 1 acre-foot of water for mixing concrete and about 120 acre-feet for dust control; however, these are estimates that may vary widely depending on weather conditions. Since each of the proposed routes makes up approximately 25 percent of the proposed transmission line system, water needs along any route would amount to about 31 acre-feet (nearly 10 million gallons).

The amount of ground water potentially available in the transmission system impact area totals 734 million acre-feet while proposed uses of water for the project would total 121 acre-feet. Regional water supplies would not be significantly depleted nor would current uses be significantly increased by the proposed project. This is especially true if use of ground and surface water would be distributed as evenly as possible over each proposed route. However, small ground and surface water supplies could be locally depleted or reduced because of heavy use for construction needs.

Disturbance of soils and vegetation and the resulting increase in sediment yield could increase the sediment load of perennial streams. It is estimated that the total increase in sediment yield would be 28 acre-feet throughout the entire proposed transmission system during the year following completion

of construction. The worst possible impact would result if the entire increase in sediment yield reached perennial streams; however, this would be unlikely because much of the proposed transmission system is far removed from such streams.

The Colorado River between Glen Canyon and Hoover dam serves to illustrate the significance of the potential increase in suspended sediment. The river carries a small amount of sediment below Glen Canyon Dam; however, tributary rivers, including those flowing into Lake Mead, carried 18 million tons during 1968, most of which settled in the lake (personal comm. Schumacher, Bureau of Reclamation, Bullhead City, Arizona, 1975).

To calculate the maximum possible increase in sediment deposited in Lake Mead attributable to construction of the proposed transmission system, it is assumed that: (1) Half the proposed transmission system would cross lands that drain to the Colorado River between Glen Canyon and Hoover dams; (2) the entire increase in sediment yield from these lands would be carried to the river; and (3) the average density of soils in the area would be 95 pounds per cubic foot. On this basis, the estimated maximum sediment increase in Lake Mead the first year after construction would be about 29,000 tons. This represents an increase of .2 percent over the average annual sediment load of 15 million tons for the years 1968 to 1972 (USGS Water Resources Data for Arizona, 1968, 1969, 1970, 1971, 1972). However, for the same period the average annual variation in sediment load was about 13 percent. With these figures in mind, it is worth noting that: (1) The potential increase in sediment load is believed to be a maximum that would occur only under ideal conditions and (2) the sediment load would return to a normal level as the sediment yield of land disturbed by construction returned to normal.

Water pollution from sources such as sanitary facilities, oil, or unused concrete would be unlikely except in areas adjacent to perennial streams. Indiscriminate dumping or accidental spills of such waste near these streams could cause a decline in water quality.

Limestone quarry impact area

An estimated 2,000 gallons of water per day would be needed to operate the proposed limestone quarry. Based on a 6-day work week this would be about 2 acre-feet per year. The participants plan to obtain the water from a well within the quarry area. This water probably would be diverted from that used naturally by rabbitbrush and other phreatophytes in the area, and would have an unmeasurable effect on the flow of the Sevier River. However, the Sevier River is fully appropriated and its basin has been designated a ground water area in which issuance of new ground water permits is restricted. Therefore, application for the required 2,000 gallons per day of ground water could result in conflicts with existing water rights in the basin.

Removal of vegetation and disturbance of soils during construction of the limestone quarry and related facilities would increase mean annual runoff from the limestone quarry impact area from an estimated 16 acre-feet to 16.4 acre-feet. By the end of the 35-year projected life of the proposed operation, the 130-acre quarry site would contribute little, if any, runoff from the impact area. Runoff from the paved and hard-surfaced areas, however, would increase significantly. The net estimated increase in mean annual runoff would be about 2.1 acre-feet per year. This is about 0.002 percent of the average annual inflow to Piute Reservoir about 30 miles downstream from the proposed limestone quarry (U.S. Dept. of Agriculture, 1971). The effects of the proposed quarry and related facilities on runoff from 2-year and 50-year storms are discussed in the soils section of this chapter.

Based on the soils section of this chapter, annual sediment yields from the limestone quarry impact area would increase from an estimated 0.13 acre-foot to about 0.17 acre-foot during construction and would decrease to about 0.08 acre-foot after construction. Effects of the increase or decrease would be

negligible with respect to sedimentation in the nearest downstream reservoir (Piute) which receives an estimated average annual sediment inflow of 124 acre-feet (U.S. Dept. of Agriculture, 1971).

The participants state the proposed quarry would not be deep enough to intersect the local ground water table. However, depth or seasonal range in depth of the local ground water table in this area are not accurately known. Consequently, it is possible the quarry could intersect the water table at least during winter and spring when the water table is highest. This would form a pond of water in the quarry thereby increasing potential for direct contamination of the ground water. Should such a pond exist during the summer, it would also create a safety problem because of the attractiveness of such ponds for swimming.

Existing data indicate that Tom Best and Reynolds springs receive most of their flow from recharge areas west of the proposed quarry. However, because those springs discharge from the same rocks that would be quarried, as well as the fractured nature of these rocks, there is probably some hydraulic connection between the springs and quarry site. It is assumed, therefore, that blasting associated with the quarry operation would eventually affect flow of the springs. There are no data available for predicting the effect - flows could decrease or increase, or water quality could change. Any change in water quality from blasting would be insignificant because of the uniform composition of the water-bearing rocks. A decrease in spring flow would decrease water available for livestock, wildlife and local irrigation proportionately. Any decrease in spring flow, however, would result in increased ground water discharge elsewhere in the local ground water system. It would not reduce the available ground water supply in the area nor would it have a measurable effect on the flow of the Sevier River.

An estimated 65 workers would be needed to operate the proposed quarry. This could increase the local population by 260 (assuming an average family of four per worker) and increase local public water supply needs by about 52,000 gallons per day (assuming average per capita daily requirement of 200 gallons) or nearly 30 acre-feet per year. Such nearby towns as Antimony and Tropic may have to increase water supplies and services accordingly.

Summary of impacts

Water used to operate the proposed quarry would be about 2,000 gallons per day (about 2 acre-feet per year). Since the ground water would come from a fully-appropriated river basin, application to appropriate an additional 2,000 gallons per day would conflict with existing water rights. The 65 quarry workers and their families could increase the combined municipal water needs of Antimony and Tropic by 41 percent. Short and long-term effects of the proposed project on mean annual runoff, sediment yields and water quality would be negligible. However, the quarry operations could affect the flow of Tom Best and Reynolds springs which are used by wildlife and livestock for local irrigation.

VEGETATION

Kaiparowits Plateau impact area

Construction phase of the proposed project would result in disturbance or total elimination of vegetation on approximately 9,460 acres, of which 7,320 acres would be permanently occupied by various associated facilities. A detailed breakdown of the area involved with each facility was discussed in Chapter I. Figure III-38 is a breakdown of the amount of vegetation and type that would be lost or disturbed as a result of this project. A more detailed breakdown with approximate acreages of disturbance within each vegetational type is shown in Appendix III-10.

FIGURE III-38

Vegetation Lost and Disturbed

Site	Disturbance During Construction (acres)	Permanently Occupied by Improvements (acres)	Vegetation Type
Generating plant	1,172	932	pinyon-juniper
Utah Power & Light 138 kV power line	27	13	pinyon-juniper
Water pipe line	620	225	mixed desert shrub, barren, and pinyon-juniper
New highway	405	280	mixed desert shrub and pinyon-juniper
Coal mine	1,814	1,649	scattered juniper, salt bush and mixed desert shrub
New community	5,000	3,900	scattered juniper, grasses, mixed desert shrub
Aggregate access road	20	15	barren and mixed desert shrub
Aggregate sites	400	317	barren and mixed desert shrub

A description of vegetation types that would be impacted by the proposed project was given in Chapter II.

The Kaiparowits area has been extensively inventoried for individual species including those on the Smithsonian list of endangered and threatened plant species published in the Federal Register by the U.S. Fish and Wildlife Service. Astragulus malacoides (endangered) and Peteria thompsoniae (threatened) occur in the Nipple Bench and Fourmile Bench areas. Euphorbia nephradenia and Viguiera soliceps (endangered), Euphorbia nephradenia and Phacelia demissa var. heterotricha (threatened) occur in the East Clark Bench area. These species could be disturbed by construction activities. Should the Smithsonian list of endangered plants be formally adopted by the U.S. Fish and Wildlife prior to construction potential hazard to these species would assume greater importance.

The participants' operation in upper Wahweap Creek, which would supply aggregate to the plant and mines, would occupy an area of approximately 70 acres. Vegetation in the channel is sparse, therefore a minimal quantity of vegetation from the gravel mining operation would be temporarily lost. This area would probably revegetate naturally to the previous state in a few years since the water table is fairly high.

Impacts on vegetation resulting from operation of the proposed generating plant and coal mine are not as direct or obvious as those impacts resulting from construction. The population increase in the area would have some impact on vegetation. Although difficult to quantify, additional camping and off-road vehicle use could severely damage vegetation in localized areas, particularly on the more fragile habitats associated with the Dakota sandstones and Tropic shales. These impacts are further compounded by extremely poor potential for successful revegetation over much of the area - less than 3 to 5 successful years out of 10.

There are no field studies yet reported in the scientific literature which demonstrate that air emissions from coal-fired power plants are beneficial

to health and growth of plant species. The major pollutant toxic to plants emitted from the Kaiparowits power plant would be sulfur dioxide (SO_2) along with nitrogen oxide (NO_x). Calculated ground-level concentrations of these gases considering "worst case" conditions and proposed and enforceable emission controls would be below concentrations which have been established for protection of vegetation from injury. The Environmental Protection Agency report on air quality criteria for sulfur oxides (EPA 1973) indicates that threshhold injury to sensitive groups of plants is approximately 0.25 to 2.0 parts per million (ppm) for a 2-hour exposure and 0.1 to 1.0 ppm for a 4-hour exposure. These levels appear to be consistent with extensive field fumigation studies with natural native species in the vicinity of power plants in Utah and New Mexico (Hill, et al., 1973, Hill et al., 1974) sulfur dioxide concentrations above 2 ppm (5,200 micrograms per cubic meter ($\mu g/m^3$)) for 2 hours were required to injure most of the 87 species studied. The data indicate that concentrations of about 1 ppm for 2 hours would be safe during most years but would cause small amounts of injury to two sensitive species, Indian rice grass (_Oryzopsis hymenoides_) and globemallow (_Sphaeralcea munroana_), in a year of unusually high rainfall. Calculated levels of SO_2 from Kaiparowits under assumed worst case conditions are predicted to be below these threshhold levels.

SO_2 concentrations of about 0.5 ppm for 3 hours were required to cause injury to the most sensitive species, when combined with an equal amount of nitrogen dioxide. These data appear to be consistent with the present secondary ambient air quality standards established to protect against effects on soil, water, vegetation and general well-being. Calculated SO_2 levels are approximately a factor of 15 below these levels. Equivalent nitrogen dioxide concentrations predicted would be 0.5 ppm, assuming all nitrogen oxides were converted to nitrogen dioxide. Under such conditions, little impact would be expected on vegetation.

Sulfur, nitrogen and mercury compounds are of greatest concern for potential impacts on aquatic vegetation in Lake Powell. Preliminary investigations indicate sulfur dioxide would probably not affect phytoplankton (minute plants) in Lake Powell. Significant increases in nitrogen compounds could influence phytoplankton population changes due to the importance of nitrogen to algae.

Investigators recently found the following levels of mercury in Lake Powell vegetation (in average parts per billion): 34 in plant leaves, 145 in plant debris and 28 in algae. This is natural mercury, since the reservoir is relatively undisturbed by man's activities at the present time. Outflow restriction in the impounded Colorado River may lead to further mercury accumulation. Mercury released by the proposed power plant could accumulate in Lake Powell plant life. The degree to which mercury enters the lake and its subsequent movement within the biological system is not well established, however it is presently being investigated (Standiford et al. 1973).

Potential effects on vegetation from cooling tower salts were discussed in the soils section. Salt accumulation in the soil could be extremely detrimental to vegetation. After 50 years, 1,375 acres would have lost 17 percent of their vegetative cover. Salt accumulation in the soil would not become stable for about 78 years, which is nearly double the expected life of the project. Based on the assumptions for analysis presented in the soils section, salt accumulation in the soil could leave some sparsely vegetated areas essentially barren of vegetative cover. This would have a secondary impact on the animal life dependent on the vegetation for food and cover.

Should the projected drift rate be less than design specifications, additional evaporation pond area would be required (as has been the experience at the Navajo generating station). This would result in additional land area requirements and concomitant additional vegetation removal. This vegetative loss

could be offset, at least in part, by reduced vegetative loss from the lower salt drift rate.

Vegetation on approximately 3,900 acres of the East Clark Bench town site would be eradicated during construction of the town. There would also be impacts on vegetation in the area adjacent to the town as a result of increased human activities, such as off-road vehicle travel, hiking, and hunting. Significance of these impacts is difficult to quantify, but there would be a reduction in vegetative cover and a change in composition, particularly in severely-impacted areas. Shrubs and perennial grasses, which are the dominant life forms on East Clark Bench, would be more susceptible to impacts from off-road vehicle travel than forbs or annuals which are in dormancy much of the year.

Transmission system impact area

Construction of the proposed transmission line would cause loss of vegetation within all vegetative communities encountered. Vegetation would be cleared for roads, tower sites, conductor pulling area, batch plants, storage and assembly areas. The total right-of-way will not be cleared. Vegetative waste materials will be chipped, shredded or scattered to prevent unsightly piles of vegetation. The impact from disposal of vegetative waste materials would be slight.

Along most of the route the proposed line would parallel existing transmission lines at varying distances within 2,000 feet. Where the proposed line would be close to existing lines, existing access roads could be used with the addition of spur roads as needed. Where lines would be spaced approximately 2,000 feet apart, new access roads would be necessary since construction of spur roads at that distance would disturb a larger area than would construction of new access roads.

Construction of the transmission line 2,000 feet from existing transmission lines would have the same impact as constructing a new line through undisturbed areas since existing access roads cannot be efficiently used. This would increase vegetative loss proportionally.

The proposed transmission line would require approximately 870 miles of new and 1,030 miles of temporary roads for the primary proposal; 735 miles of new and 1,030 miles of temporary roads for the northern Kaiparowits proposal and 1,055 miles of new and 1,030 miles of temporary roads for the Arizona Strip proposal. Assuming a road width requirement of 14 feet, this would result in 3,235 acres of vegetation disturbed for roads along the primary proposal; 3,005 acres for the northern Kaiparowits proposal and 3,545 acres for the Arizona Strip proposal.

Figures III-39, -40, -41 show by vegetative community the total acres of vegetation removed or disturbed for each of the three transmission line proposals. This includes construction of roads, tower sites, conductor pulling areas, batch plants and storage and assembly areas.

The pinyon-juniper woodland and Mohave and Sonoran desert scrub communities would receive the greatest impact from construction of the proposed transmission line because of the long period required to reestablish these vegetative types. Pinyon-juniper requires decades to reach maturity. Some desert scrub communities also require decades to mature because of the arid climate.

Unique vegetation would be disturbed on the Kaiparowits Plateau (very old pinyon and juniper trees), the areas of Willow Hole, Hidden Palms, Pushawalla Palms and other palm oases (fan palm trees) and Las Vegas Wash (riparian vegetation). The impact from loss of this unique vegetation could be great, as with the fan palm which is rare. Old pinyon and juniper trees have some scientific value and could not be replaced in hundreds of years. The loss of the particular stand of riparian vegetation in Las Vegas Wash would be a lesser impact since moisture there is primarily sewage effluent from the City of Las Vegas and has limited aesthetic values. Riparian vegetation regrows fairly rapidly if the moisture source on which it depends is not destroyed.

Figures III-42, -43, -44 show those acres of vegetation removed or disturbed by construction of the proposed line. The impacts are quantified in estimated animal unit months (AUMs) of livestock/wildlife forage lost annually during the construction period by each of the three proposals. After construction is complete, annual and perennial vegetation would re-establish and the loss of forage AUMs would decrease.

Figure III-45 shows by vegetative community, miles, acres disturbed and estimated AUMs that would be lost within the Navajo Indian Reservation under each

FIGURE III-39

Primary Proposal - Occupied and Disturbed Miles and Acreage by Vegetative Communities

Vegetative Community	Kaiparowits to Phoenix			Kaiparowits to Navajo			Kaiparowits to Moenkopi to Mohave			Kaiparowits to Eldorado			Mohave to Serrano			TOTALS		
	Miles	Permanently Occupied Acres	Total Disturbed Acres	Miles	Permanently Occupied Acres	Total Disturbed Acres	Miles	Permanently Occupied Acres	Total Disturbed Acres	Miles	Permanently Occupied Acres	Total Disturbed Acres	Miles	Permanently Occupied Acres	Total Disturbed Acres	Miles	Permanently Occupied Acres*	Total Disturbed Acres*
Pinyon-juniper woodland	84	10	790	16	2	152	89	159	559	32	69	213				221	240	1,714
Great Basin desert scrub	97	11	911	28	3	265	93	165	584	82	177	546				300	356	2,307
Plains & desert grassland	51	6	479	3		28	88	158	553	16	35	106				158	199	1,166
Mohave desert scrub	0						36	64	226	113	243	752	380	288	1,399	529	595	2,376
Riparian (woodland)	5	1	47				2	4	13							7	5	60
Chaparral (interior)	17	2	160													17	2	160
Sonoran desert scrub	45	5	423													45	5	423
Coastal sagescrub													6	5	22	6	5	22
Urban-agricultural													58	44	213	58	44	213
Joshua tree woodland										26	56	173				26	56	173
Chaparral (coastal)													90	68	331	90	68	331
Total	299	35	2,810	47	5	445	308	550	1,935	269	580	1,790	534	405	1,965	1,457	1,575	8,945

*Permanently occupied acres and disturbed acres are calculated from Figure III-31.

FIGURE III-40

Northern Kaiparowits Proposal - Occupied and Disturbed Miles and Acreage by Vegetative Communities

Vegetative Community	Kaiparowits to Phoenix			Kaiparowits to Navajo			Kaiparowits to Moenkopi to Mohave			Kaiparowits to Eldorado			Mohave to Serrano			TOTALS		
	Miles	Permanently Occupied Acres	Total Disturbed Acres	Miles	Permanently Occupied Acres	Total Disturbed Acres	Miles	Permanently Occupied Acres	Total Disturbed Acres	Miles	Permanently Occupied Acres	Total Disturbed Acres	Miles	Permanently Occupied Acres*	Total Disturbed Acres*	Miles	Permanently Occupied Acres	Total Disturbed Acres
Pinyon-juniper woodland	84	10	790	16	2	152	32	32	120	32	69	213				164	113	1,275
Great basin desert scrub	97	11	911	28	3	265	82	87	307	82	177	546				289	273	2,029
Plains & desert grassland	51	6	479	3		28	16	16	60	16	34	106				86	56	673
Mohave desert scrub							159	157	596	113	244	752	380	288	1,399	652	689	2,747
Riparian woodland	5	1	47													5	1	47
Chaparral (interior)	17	2	160													17	2	160
Sonoran desert scrub	45	5	423													45	5	423
Coastal sagescrub													6	5	22	6	5	22
Urban - agricultural													58	44	213	58	44	213
Joshua tree woodland							38	38	142	26	56	173				64	94	315
Chaparral (coastal)													90	68	331	90	68	331
Total	299	35	2,810	47	5	445	327	325	1,225	269	580	1,790	534	405	1,965	1,476	1,350	8,235

*Permanently occupied areas and disturbed acres are calculated from Figure III-31.

FIGURE III-41

Arizona Strip Proposal - Occupied and Disturbed Miles and Acreage by Vegetative Communities

Vegetative Community	Kaiparowits to Phoenix			Kaiparowits to Navajo			Arizona Strip to Eldorado			Arizona Strip to Mohave			Mohave to Serrano			TOTALS		
	Miles	Permanently Occupied Acres	Total Disturbed Acres	Miles	Permanently Occupied Acres	Total Disturbed Acres	Miles	Permanently Occupied Acres	Total Disturbed Acres	Miles	Permanently Occupied Acres	Total Disturbed Acres	Miles	Permanently Occupied Acres	Total Disturbed Acres	Miles	Permanently Occupied Acres *	Total Disturbed Acres *
Pinyon-juniper woodland	84	10	790	16	2	152	58	134	413	58	162	669				216	308	2,024
Great basin desert scrub	97	11	911	28	3	265	50	116	357	50	140	577				225	270	2,110
Plains & desert grassland	51	6	479	3		28	40	92	285	40	112	462				134	210	1,259
Mohave desert scrub							89	206	635	135	378	1,557	380	288	1,399	604	872	3,591
Riparian (woodland)	5	1	47													5	1	47
Chaparral (interior)	17	2	160													17	2	160
Sonoran desert scrub	45	5	423													45	5	423
Coastal sagescrub													6	5	22	6	5	22
Urban-agricultural													58	44	213	58	44	213
Joshua Tree woodland							14	32	100	26	73	300				40	105	400
Chaparral (coastal)													90	68	331	90	68	331
Total	299	35	2,810	47	5	445	251	580	1,790	309	865	3,566	534	415	1,965	1,440	1,890	10,575

*Permanently occupied acres and total disturbed acres are calculated from Figure III-31.

FIGURE III-42

Primary Proposal - Animal Unit Months Lost Temporarily and Permanently By Vegetative Community

Vegetative Community	Estimated Average Carrying Capacity[b] (acre/AUM)	AUMs Lost					
		Kaiparowits to Phoenix	Kaiparowits to Navajo	Arizona Strip to Eldorado	Arizona Strip to Mohave	Mohave to Serrano	Total
Pinyon-juniper woodland	25	32	6	22	9		69
Great basin desert scrub	30	30	9	20	18		77
Plains & desert grassland	8	60	4	69	13		146
Mohave desert scrub	30			8	25	47	80
Riparian & riparian woodland	10	5		1			6
Chaparral (interior)	20	8					8
Sonoran desert scrub							
(Arizona upland & lower Colorado)	30	14					14
Coastal sagescrub	15					2	2
[a]Urban agriculture							
Joshua tree woodland	15				12		12
Chaparral (coastal)	20					17	17
Total		149	19	120	77	66	431

[a]Urban agriculture land not generally used for rangeland livestock grazing
[b]Estimated average carrying capacity for livestock

FIGURE III-43

Northern Kaiparowits Proposal - Animal Unit Months Lost Temporarily and Permanently by Vegetative Community

Vegetative Community	Estimated Average Carrying Capacity[b] (acre/AUM)	AUMs Lost					
		Kaiparowits to Phoenix	Kaiparowits to Navajo	Arizona Strip to Eldorado	Arizona Strip to Mohave	Mohave to Serrano	Total
Pinyon-juniper woodland	25	32	6	9	5		52
Great basin desert scrub	30	30	9	18	10		67
Plains & desert grassland	8	60	4	8	13		85
Mohave desert scrub	30			25	20	47	92
Riparian & riparian woodland	10	5					5
Chaparral (interior)	20	8					8
Sonoran desert scrub (Arizona upland & Lower Colorado)	30	14					14
Coastal sagescrub	15					2	2
[a]Urban agriculture	-	-					
Joshua tree woodland	15	-		12	9	17	38
Chaparral (coastal)	20						
Total		149	19	72	57	66	363

[a]Urban agriculture land not generally used for rangeland livestock grazing
[b]Estimated average carrying capacity for livestock

FIGURE III-44

Arizona Strip Proposal - Animal Unit Months Lost Temporarily and Permanently by Vegetative Community

Vegetative Community	Estimated Average Carrying Capacity[b] (acre/AUM)	AUMs Lost					
		Kaiparowits to Phoenix	Kaiparowits to Navajo	Arizona Strip to Eldorado	Arizona Strip to Mohave	Mohave to Serrano	Total
Pinyon-juniper woodland	25	32	6	17	27		82
Great Basin desert scrub	30	30	9	12	19		70
Plains & desert grassland	8	60	4	36	58		158
Mohave desert scrub	30			21	52	47	120
Riparian & riparian woodland	10	5					5
Chaparral (interior)	20	8					8
Sonoran desert scrub (Arizona Upland & Lower Colorado)	30	14					14
Coastal sagescrub	15					2	2
[a] Urban agriculture	-						
Joshua tree woodland	15			7	20		27
Chaparral (coastal)	20					17	17
Total		149	19	93	176	66	503

[a]Urban agriculture land not generally used for rangeland livestock grazing
[b]Estimated average carrying capacity for livestock

FIGURE III-45

Primary Proposal - Number of Miles, Acres Disturbed and Estimated AUMs Lost Within the Navajo Indian Reservation

Vegetative Community	Kaiparowits to Navajo			Kaiparowits to Mohave			Kaiparowits to Phoenix			Totals			AUM	
	Miles	Perm. Occup. Acres	Total Disturbed Acres	Miles	Perm. Occup. Acres	Total Disturbed Acres	Miles	Perm. Occup. Acres	Total Disturbed Acres	Miles	Perm. Occup. Acres	Total Disturbed Acres	Perm.	Total
Pinyon-juniper woodland				5	9	31	20	2	188	25	11	219	0	9
Great-basin desert scrub	3	.33	28	73	131	460	72	9	677	148	140	1,165	5	39
Mohave desert scrub				9	16	56				9	16	56	1	2
Totals	3	<1	28	87	156	547	92	11	865	182	167	1,440	6	50

FIGURE III-46

Northern Kaiparowits and Arizona Strip Proposal
Number Miles, Acres Disturbed and Estimated AUM Lost

Vegetative Community	Kaiparowits to Navajo			Kaiparowits to Phoenix			Total			AUM	
	Miles	Perm. Occup. Acres	Total Disturbed Acres	Miles	Perm. Occup. Acres	Total Disturbed Acres	Miles	Perm. Occup. Acres	Total Disturbed Acres	Perm.	Total
Pinyon-juniper woodland				20	2	188	20	2	188	<1	8
Great-basin desert scrub	3	.33	28	72	9	677	75	9	705	<1	24
Totals	3	<1	28	92	11	865	95	11	893	<1	32

proposal. The acreage affected and the AUMs impacted would be the same for both the Northern Kaiparowits proposal and the Arizona Strip proposal (Figure III-46).

The impact of AUM loss within the Navajo Indian Reservation because of vegetation destruction would be minimal. The annual estimated loss during construction would be 50 AUMs on the primary proposal and 32 AUMs on the Northern Kaiparowits and Arizona Strip proposals. This would amount to loss of forage for 21 sheep for a year on the primary proposal and 14 sheep for a year on the Northern Kaiparowits and Arizona Strip proposals. This is over a distance of 182 miles on the primary proposal and 95 miles on the Northern Kaiparowits and Arizona Strip proposals. Over this area, individual families would be expected to be affected to a very slight degree. This loss would gradually be reduced as annual and perennial vegetation reestablishes on disturbed areas.

The proposed transmission line crosses Hualapai Indian Reservation only on the primary proposal. The transmission line would cross the plains and desert grasslands community for a distance of 10 miles and the pinyon-juniper woodland community for a distance of 5 miles. This segment would disturb 113 acres, of which 18 acres would be permanently occupied in the plains and desert communities. In the pinyon-juniper woodland community, 56 acres would be disturbed and 9 acres permanently occupied. This would be an estimated annual loss of 16 AUMs within the reservation, of which two AUMs would be permanently lost on an annual basis. Sixteen animal unit months is little more than the annual forage needs for one cow.

Construction of new roads into previously undisturbed areas would increase opportunities for off-road vehicle travel and a subsequent increase in vegetative disturbance. During construction, there would be direct loss of some protected or rare and endangered plant species. These species often have low populations and removal of a few individual plants may significantly affect the

entire population. Other protected species such as some of those in the Cactacae (cactus) Family have large populations and will be less adversely impacted if a few individual plants are removed.

The following protected plants either occur or may occur along the proposed routes in Arizona: Washingtonia filifera (fan palm), Lysiloma thornberi (ornamental tree), Bursera fagaroides (elephant tree), Cereus schottii (senita or "old one"), Cereus thurberi (organ pipe cactus), Toumeya papyracantha (toumeya), Tourmeya peeblesiana (toumeya), Neoevansia diguetii (dahlia cactus), Pediocactus paradine, (pediocactus).

Species of the families: Lliliaceae (lily family), Amaryllidaceae (amaryllis family), Orchidaceae (orchid family), Crassulaceae (orpine family), Cactaceae (cactus family).

Species of the genera: Aaquilegia (columbine). Lobelia (lobelia), Dodecatheon (shooting star), Primula (primrose), Forquieria (ocotillo).

Species: Atriplex hymenelytia (desert holly), Cercis occidentalis (western redbud), Dalea spinosa (smoke tree), Hola cantha crnoryi (crucifixion thorn) and Fremontia california (flannel bush), (Arizona native plant law, 1972).

The following plants are considered rare and endangered by the California Native Plant Society and either occur or may occur along the proposed routes in California: Broadea filifolia (brodiaea), Coryphantha vivipara alversonii (foxtail cactus), Hemizona mohavensis (Mohave turweed), Dudley saxosa aloides (live forever), Ditaxis aden ophora (ditaxis), Ditaxis california (California ditaxis), Linanthus arenocola (linanthus), Corizanthe leptoceras (chorizanthe) and Ayenia compacta (desert ayenia) (California Native Plant Society, 1972).

The endangered or threatened plant species listed in the Smithsonian report to the Congress of the United States for the four states crossed by the proposed transmission line are listed in the Appendix II-12. The endangered or threatened plants species that may occur in southern Utah or northern Arizona

(Atwood, Personal Correspondence) also are listed in the Appendix II-11. Some of these endangered or threatened plant species may occur along the proposed transmission line within the states listed.

The protected or rare and endangered plants would be affected by direct removal or indirectly by changing site characteristics through soil disturbance and compaction from construction. If the sites are significantly changed, they may no longer be capable of supporting the above species. Proposed construction could also prevent reproduction of the above species within the disturbed areas. The permanently-occupied sites would be cleared of vegetation and any protected rare or endangered species in those disturbed areas would be lost. The impact would be the aesthetic and scientific loss of these protected or rare and endangered species for future observation or study.

Actual numbers or concentrations of protected or rare and endangered plant species are not known; however, some protected families such as the Cactaceae and Liliaceae have large numbers of species that occur over much of the proposed routes. These families include cactus and yucca species respectively. The impact of loss of a few individuals of these species would not be significant to the population compared to the loss of a rare, single fan palm tree. It is not possible to analyze completely the impact from loss of any particular protected rare or endangered plant species. Quantative impacts in terms of number of plants, species, etc. cannot be predicted because data are lacking on population densities, distribution, and limiting factors of protected, rare, endangered and threatened plant species along the proposed transmission route, and the exact on-the-ground location of roads, towers, etc., are not known.

If the Smithsonian list of endangered plants is formally adopted by the U.S. Fish and Wildlife Service prior to construction, presence of any of these plants would be a significant factor in route selection. Also, site specific studies prior to construction would be necessary should the project be approved.

If the proposed transmission line were constructed, vegetation would be cleared for access roads and tower sites. Vehicles and equipment would compact soil which would increase water runoff, This would result in a loss of soil moisture on the site. The site or disturbed areas would then become more arid. Increased aridity would likely lead to establishment of different species on the changed site. Generally, annuals such as cheatgrass, red brome and Russian thistle would be the first species to inhabit the disturbed site. These annuals would be followed by perennial species such as snakeweed and rabbitbrush. Gradually the site would become more mesic as succession moved toward climax status.

Construction of communication sites would also result in direct removal of vegetation. Less than 5 acres of vegetation would be effected by this construction since no new roads are proposed for these sites. Impacts from loss of this vegetation would be minimal unless rare or unique species habitat were involved. These sites are not generally suitable for livestock grazing but would be used by some species of wildlife. Since the acreage involved is so small the impact would likely be small unless some critical element of habitat were involved.

Fire risk in the construction area would greatly increase due to increased human presence and their use of vehicles and equipment. The effect of a fire on vegetation could be significant in that large areas could be burned with a loss of vegetative cover and man-made improvements. The impact from loss of improvements and temporary loss of forage could be great in both time and expense to any individual grazier. Fire could put an individual ranch temporarily out of business. The impact on livestock grazing on a larger scale would not likely be significant as a result of fire.

Beneficial impacts may result from a fire in disturbed areas where plant succession takes place in pinyon-juniper and grassland vegetation communities.

These areas could end up with a greater density of ground cover and produce more forage than the native cover. Fires would destroy tree and shrub canopy and give the native grasses a chance to grow. On some vegetative types i.e. pinyon-juniper, desert scrub, a fire might result in an increase in grass and forb cover. This lower successional stage could provide more forage. Burned areas could also be seeded to increase forage production.

Key riparian areas would mostly be spanned by the line, however, they could be disturbed during construction from building of access roads and by heavy equipment moving through these areas. The adverse impact to this vegetation would be temporary if the water source supporting this habitat type were not changed or destroyed. Riparian and aquatic habitat is very limited along the proposed routes. Because of this scarcity, this habitat type is more valuable to add diversity to an otherwise uniform expanse of large tracts of single plant communities. Aquatic and riparian habitat also support relatively high wildlife population in both numbers and variety of species.

Limestone quarry impact area

Vegetation would be removed from about 130 acres in the proposed quarry area. In addition, approximately 110 acres of vegetation would be removed, covered, or otherwise disturbed by surface operations such as the shop/office facilities, magazine area, limestone stockpile, access roads, and the upgrading of existing roads along the haulage route.

Sagebrush and grass communities would be primarily affected at off-quarry sites. The quarry operation would involve removal of trees as well, primarily pinyon pine and juniper, plus scattered ponderosa and bristlecone pine.

Removal of vegetation would increase sediment loads in streams that drain this area (see soils and water sections). Until revegetation takes place, livestock and certain wildlife species would be displaced from the affected areas. Some portions of the 130 acres would probably not be revegetated and it is not known if the site would have a comparable vegetative productiveness after mining.

At least one plant species (Panguitch buckwheat) on the federal list of threatened and endangered plants occurs in this area.

WILDLIFE

Kaiparowits Plateau impact area

Structural features of the generating plant would permanently eliminate about 930 acres of predominately pinyon-juniper woodland habitat interspersed with small areas of sagebrush and other shrubs. This habitat, together with adjacent narrow ravines has the capability of supporting about 10 mule deer year round or about 30 seasonally. This productivity would be lost and the general deer population reduced by about 30 animals. Structural features also would create barriers to movements of some wildlife, making a portion of the remaining habitat less readily available. It is not likely that crucial migration routes for major populations of wildlife would be completely blocked.

Diverse populations of other wildlife would also be lost, including eagles, hawks, ravens, mourning doves, other small birds, jackrabbits, numerous small rodents, and predator mammals.

Cooling tower salts would have a cumulative adverse effect on terrestrial wildlife by altering vegetation. As discussed in the section on soils, a salinity of 4×10^3 millimhos is considered the upper limit of tolerance by pinyon-juniper and sagebrush. These plant communities in combination are important to many species of wildlife and their elimination would adversely affect wildlife populations. The exact impact on wildlife is difficult to predict, but the following example illustrates the approximate magnitude.

About 140 acres of predominately pinyon-juniper woodland on Fourmile Bench would be lost by the end of 5 years, and this loss would reach about 1,375 acres by the end of 50 years. This 1,375 acres of habitat, which is in addition to that eliminated by structural features, has the capability of supporting about 20 mule deer year-round or 60 seasonally. This productivity would be lost.

The water pipe line would permanently eliminate about 225 acres. This would include about 25 acres of pinyon-juniper woodland similar to that of the plant site and with proportionate losses of the same types of wildlife. About 100 acres of salt desert shrub-desert grass habitat for small mammals, perching birds, raptors and predator mammals would be eliminated by the pipe line, as well as about 100 acres of essentially barren land supporting very little wildlife.

When water levels in Lake Powell are near the maximum of 3,700 feet, the pumping station intake would be approximately 200 feet below the surface. Under these conditions, there should be no serious problem of fish being drawn into the system. However, fish mortality could become a problem with water levels at 3,550 feet or lower. The time-elevation curve for Lake Powell prepared by the Bureau of Reclamation shows this low level occurring about 10 percent of the time during the life of the plant.

Pollutants potentially hazardous to fish and wildlife would occur in stack emissions, salts from cooling tower drift, and in disposal areas for ash and scrubber wastes. The participants propose extensive measures during operations to minimize hazards. Preliminary findings of on-going studies by Brigham Young University and Northern Arizona University indicate that predicted concentrations of most pollutants except cooling tower salts, are below the minimum level currently known to be injurious on a short-term basis to animals or to vegetation on which animals feed. However, large quantities of potentially harmful materials would be produced and stored, and unforeseen circumstances could release some of these in unexpected concentrations. The probability of this happening may be slight, but it does exist. Effects of long-term plant and animal exposure to low levels of some pollutants are not known. However, some are known to have cumulative effects or to become concentrated through bioamplification.

Pollutants such as fluorine, mercury, selenium, arsenic, and sulfur dioxide can be directly harmful to animals. Others affect animal life indirectly

by altering vegetation. Mercury would probably have little impact on terrestrial communities because biological amplification of this element is comparatively low when the mercury source is soils or plants. However, some mercury would be carried into the aquatic environment where it would amplify through the food web and could adversely affect animal life or render fish unsafe for human consumption. Low levels of mercury can also affect fish indirectly by inhibiting growth and reproduction of algae, a primary source of food.

Mercury is of particular concern to the fishery of Lake Powell for several reasons. Natural weathering and runoff already contribute mercury amounts that come close to rendering game fish unsafe for human consumption. Present mean levels of mercury in the water range from 0.01 to .1 part per billion (ppb) and mercury levels in some largemouth bass and walleye exceed 500 ppb, the upper limit for human consumption recommended by the Food and Drug Administration. Mercury is amplified within the aquatic food web. Therefore, a small increase in mercury content of the water can cause a much greater increase of mercury in predator fish. This is well demonstrated by the existing condition where 0.01 to 0.1 ppb mercury levels in the water cause over 500 ppb of mercury in fish.

Fish, with the help of various bacteria, have the ability to methylate inorganic mercury directly in the intestines and in the slime on the outside of the fish (Hesse et al., 1975). This lends credence to the statement that practically all mercury in fish is of the methylated form (Hesse et al. 1975). Methyl mercury is the biologically toxic form.

Fish-eating birds frequently accumulate mercury levels equal to or higher than that of the fish on which they feed. Double-crested cormorants from a mercury-contaminated watershed in South Dakota were found to contain a mean mercury concentration in their livers of 3,090 ppb (Hesse et al. 1975). Fish-eating birds in the Lake Powell and Kaiparowits area are not particularly numerous but those that do exist would be exposed to this potential hazard.

High levels of mercury can be directly fatal to birds. An average of 88 ppm (8,800 ppb) was found in livers of ringnecked pheasants fed methyl mercury until death (Hesse et al., 1975). Liver mercury residues of 1700 ppb proved fatal to adult red-tailed hawks (Hesse et al., 1975). Lower, nonlethal levels of mercury can cause decreased egg production and an increased percentage of shell-less eggs (Hesse et al., 1975).

Many variables and unknowns make an exact prediction of future mercury levels in Lake Powell fish and fish-eating birds impossible. Any prediction is necessarily based on a number of assumptions and estimates. These include the amount of coal burned, mercury content of the coal, level of emission control, percentage of emitted mercury entering Lake Powell, and the rate of accumulation by fish through bioamplification within the aquatic biome and/or direct absorption from the water.

Bioamplification of mercury varies considerably in different aquatic ecosystems. In some heavily-polluted waters fish exhibit relatively low levels of mercury. The opposite is true of Lake Powell where mercury levels in fish are exceptionally high though mercury levels of the water are relatively low.

An estimated 16 to 480 pounds of mercury from stack emissions would enter Lake Powell annually (see air quality section for calculations) representing from 1 to 27 percent of the accumulation from natural sources. The existing Navajo power plant would contribute an estimated additional 140 pounds annually. The combined contribution of the two plants would be from 156 to 620 pounds of mercury annually or from 9 to 35% of the natural mercury input.

The exact amount of increase in mercury levels of game fish that would result from this increment of mercury in the reservoir is uncertain. However, the current rate of amplification indicates that some increased concentration of mercury in fish would be highly probable. Also, the possibility exists that

present mercury levels of Lake Powell represent a threshhold beyond which almost any increase could impair productivity of the aquatic biome.

If gamefish of Lake Powell were to become inedible because of mercury contamination, the most drastic impact could be complete abandonment of the fishery by the public. This would mean an annual loss of about 127,800 man-days of high-quality sportfishing at present level of use, or about 217,000 man-days at the end of 35 years based on current trends.

Perhaps a more probable impact would be a lowering of recreational quality. Fish accumulating the highest mercury levels (Standiford et al., 1973) are large individuals of the carnivorous game fish species, particularly largemouth bass and walleye. Striped bass, recently introduced into the reservoir, could also be expected to accumulate high mercury levels as this is a large and highly carnivorous species. Fishes most highly prized by the angler are the ones most likely to accumulate mercury levels that would render them unsafe for human consumption. Therefore, an increase in mercury levels would probably cause a shift in fishing emphasis from the highly esteemed largemouth bass to smaller forage fish such as bluegill which accumulate less mercury.

Any increase of mercury in Lake Powell probably would also cause a slight reduction in productivity of the fishery by inhibiting growth and reproduction of algae. This impact would be overshadowed by the more imminent problem of the fishery becoming essentially unusable by man or being lowered in recreational value.

Although the many uncertainties make exact quantification of impacts impossible at this time, certain basic facts can be summarized.

1. The generating plant's contribution of mercury to Lake Powell would probably be small compared to the amount contributed naturally by the watershed.

2. Large game fish of Lake Powell presently contain mercury concentrations exceeding the 500 ppb maximum safe level for human consumption established by FDA.
3. Most of the mercury (about 90%) in the fish is methyl mercury, the biologically toxic form.
4. Mercury in Lake Powell undergoes a high rate of bioamplification with the present concentration of from 0.01 to 0.1 ppb in the water causing concentrations of over 500 ppb in large carnivorous fish. Therefore, even a small increase in mercury levels of the water could cause a much greater increase of mercury levels in fish.
5. A significant increase in mercury levels of game fish would cause some degree of loss to the Lake Powell sport fishery. The degree of loss could range from a slight lowering of quality to complete loss of fishery to public use depending on the degree of contamination.
6. Based on present information, it cannot be stated positvely that the Lake Powell fishery would suffer a major catastrophe because of mercury emissions from the Kaiparowits generating plant. Neither can it be positively stated that some degree of loss, possibly major, would not occur. It must be recognized that a potential hazard would be present. Should the project be constructed careful monitoring would be essential.

Mercury accumulated in the bottom sediments of Lake Powell would probably remain long beyond the project life.

Excessive amounts of some nutrients can stimulate such heavy growth of algae and other plankton that fish are killed by oxygen depletion (Mackenthun,

1967). Nitrogen compounds are a common cause of excessive plankton growth. Therefore a significant increase in nitrogen compounds could adversely impact the Lake Powell fishery. However, in light of the enormous volume of water in Lake Powell (approximately 27,000,000 acre-feet), and the quantities of nutrients already entering the lake primarily from the Colorado and San Juan rivers, it is questionable if nitrogen contribution from the project would produce a measurable change in phytoplankton growth or associated fish populations within the foreseeable future. Over a long period of time project-attributable nitrogen compounds would comprise a small incremental contribution towards ultimate eutrophication of the reservoir.

Mercury has an affinity for organic materials (Standiford et al., 1973). Therefore, any increase in organic sediments due to elevated nitrogen levels would tend to increase mercury accumulation and aggravate the problem of mercury contamination in game fish. Additional discussion of effluent impacts on plant life is contained in the vegetation section.

Fly ash in sufficient quantities can harm wildlife indirectly by coating terrestrial vegetation and reducing photosynthesis. Fish life can be harmed by ash deposits on critical spawning areas. Predicted quantities of fly ash at Kaiparowits probably would not be serious in either of these respects. A more likely problem would be long term, cumulative effects of trace elements carried by fly ash and deposited on soil, water and vegetation. Potential effects of mercury were discussed in preceding paragraphs.

Acid rain can occur when atmospheric moisture combines with sulfur dioxide in the air to form a weak acid solution capable of damaging terrestrial and aquatic habitat. Most occurrences have been in eastern industrialized areas where both sulfur dioxide concentrations and precipitation are much greater than would be expected in the project area. In the arid Kaiparowits Basin acid rain

would be expected only under a rare combination of conditions. For example, if the scrubber system were out of commission for an extended period, a temperature inversion concentrated the emissions, and one of the few rains of the year occurred at that time.

Effect of acid rain, should it occur, or other forms of acid emissions on biological resources is uncertain. In humid regions where soils and waters are naturally acidic (low pH) further lowering of the pH by acid rain or acid fly ash has eliminated fish life from some waters and drastically reduced productivity of terrestrial habitat. In the arid Kaiparowits Plateau impact area most soils and waters are basic (high pH). Waters of Lake Powell have a pH level of about 8.5 (7.0 is considered neutral). Productivity of soils in this area is often inhibited by naturally high salinity and/or alkalinity. Under these conditions it is questionable if moderate lowering of pH would decrease productivity of fish and wildlife habitat within the near future. Long term, cumulative effects are unknown as a 3,000 megawatt plant has never been operated in this area.

An estimated 11 tons of salts from cooling tower drift would be carried annually into Wahweap and Warm creek arms of Lake Powell. This amount would be small compared with approximately 1,000 tons of salt estimated to be carried annually by natural runoff of these drainages and extremely minute related to the 8,000,000 tons of salt carried annually by the Colorado River. Therefore, the average annual salt contribution from cooling tower drift would probably have little effect on aquatic habitat of the Wahweap or Warm creek arms of Lake Powell.

A future hazard would result from accumlated salts remaining in cooling water evaporation ponds after abandonment of the project. Natural erosion would be expected to eventually wear away retaining dikes until a high-intensity storm could carry many years accumulation of salts into the reservoir within a short period of time. Adverse impact on aquatic habitat would be localized near the

heads of the coves and would be temporary. Salts would be diluted by the receiving waters, probably within a few years. No measurable change in overall salinity of Lake Powell would be expected.

Some potential future hazard of unknown magnitude or probability would be created for all animal life, including invertebrates and microorganisms, by the long term, accumulative effect of some toxic substances besides mercury in plant emissions. Some of the better known toxic emissions include selenium, arsenic, fluorine, ozone and sulfur dioxide.

Certain plants, some of which are found on the Kaiparowits Plateau and surrounding area, are able to extract selenium from the soil and concentrate the element in amounts toxic to livestock (Louderback 1975). It is possible that long term accumulations of selenium in the soil could cause concentrations in some vegetation toxic to animals.

Arsenic is cumulative in both plant and animal tissue (Whitacre 1974) particularly in an aquatic environment but also to a lesser degree in a terrestrial biome. The toxicity of some compounds of arsenic to invertebrates is indicated by their widespread use in insecticides.

Ozone, a powerful oxidant, could occur in sufficient concentrations particularly during air stagnation periods to eventually harm plant life and animals dependent on the plants.

Microscopic-sized particles of flyash would have the potential for entering respiratory systems of animals, both vertebrate and invertebrate with unknown ultimate effects.

Although the severe short term biological damage from acid rain or mist that has occurred in humid regions would not be likely with the arid climate and basic soil and waters of the Kaiparowits Plateau region, a more subtle long term, cumulative adverse effect could eventually manifest itself.

The likelihood or magnitude of the above hazards cannot be determined accurately at this time. However, the fact that long term potential hazards exist should be recognized.

Mine facilities on John Henry Bench and Smoky Mountain would eliminate about 1,649 acres of mixed shrub-grass, scattered juniper habitat. This would also eliminate moderate populations of small mammals, perching birds and reptiles. Mule deer use of the area is slight and losses to this species would be low.

On several thousand additional acres peripheral to the mine and plant site, populations of larger wildlife including deer, raptors and predators would be reduced to some extent by increased human disturbance. Elimination of live-stock forage at the plant site would cause increased competition between livestock and wildlife on the surrounding area unless livestock grazing allotments were appropriately reduced.

Springs and seeps crucial to some wildlife could be adversely affected, primarily by coal mining operations. Mining could eliminate or seriously reduce flows of Tibbet Springs, Drip Tank Canyon, and possibly others by water percolating into the mine. Springs and seeps could be further reduced by pumping large quantities of ground water from the mine. During long dry periods typical of the impact area, the range of some species is limited to habitat within approximately 1 mile of water. This is true of ground-dwelling game birds such as quail and chukar, and some large mammals, particularaly when young are being reared. Therefore, loss of one water source could eliminate some species of wildlife from about 3 square miles, or 2,000 acres of otherwise suitable habitat.

The proposed two parallel 69 kV wood pole power lines from the plant to the pumping station would be of a type and size conducive to electrocution of eagles and other large raptors. The 22 miles of Utah Power & Light 138 kV permanent power line to the mine would present less electrocution hazard because of wider

spacing of conductors. The towers would provide attractive perches near an access road thus increasing vulnerability of the large birds to indiscriminate shooting.

The proposed townsite on East Clark Bench would convert approximately 3,900 acres of largely desert shrub and grassland habitat to an urban environment. This would eliminate most wildlife except some small birds that adapt readily to human habitation. The proposed townsite is in the heart of existing antelope range. The combination of habitat loss and increased disturbance and harassment would very likely eliminate this small, recently reintroduced antelope herd. The major impact on antelope would be the existence of the town and associated proliferation of human activity. In this regard the exact location and size of the town would be relatively minor details.

If water for the town comes from wells, withdrawal of about 9,690 acre-feet of ground water annually could eventually reduce flows of springs and seeps in the Wahweap Creek drainage. Complete loss of any of these water sources would eliminate some species of wildlife from that vicinity.

Effects of the town would be less severe or widespread on most small wildlife than it would on big game and large predators. However, near the town some native small mammals and birds would face increased competition from introduced species such as Norway rats, house mice, house sparrows, and starlings. Some populations would be reduced by depredation of dogs and cats. Populations of some small birds would probably increase within the town in response to increased availability of water and to the planting of trees and grass.

Outdoor activities of the increased human population would impact fish and wildlife more than the new town site itself. In fact, the greatest single impact of the entire project would likely be the "people impact" in an area now largely uninhabited. Increased disturbance from outdoor activities and increased harassment, poaching and indiscriminate shooting, as well as increased legal

hunting pressure would have a cumulative adverse impact extending far beyond the mine and plant site impact area, and the new urbanized area. Much of the surrounding terrain is a type that attracts the use of off-road vehicles. A great increase in this activity could be expected.

Other principal areas where wildlife resources would suffer from increased human activity include Aquarius Plateau, Boulder Mountain, the Henry Mountains, Fiftymile Mountain, and Lake Powell.

The free-roaming Henry Mountains bison herd is highly vulnerable to poaching. This problem would be compounded by human activity associated with the project. The present remote and inaccessible quality of Fiftymile Mountain that makes it a sanctuary for mountain lion and an ideal site for reintroduction of bighorn sheep would also be adversely altered by increased human activity.

The extremely rugged terrain of Fiftymile Mountain would be a strong deterrent to extensive use of off-road vehicles. However, some increase in human intrusion by foot and horseback would be almost certain.

Wild turkeys on the south slopes of Aquarius Plateau and Boulder Mountain would be directly in the path of much of the increased human activity. This species is highly vulnerable to disturbance during nesting season and while young are being reared. Turkey populations may be expected to decline as a result. Also, successful hunting of turkeys requires relatively uncrowded conditions and freedom from disturbance. Therefore, increased human population would adversely affect hunting conditions as well as biological productivity.

At present, remoteness and difficult access tend to keep fishing activity in balance with the somewhat limited productivity of small high mountain lakes on Boulder Mountain and the Aquarius Plateau. Increased fishing due to an expanded human population would increase competition and lower angling success. In the past a frequent secondary result of heavy fishing pressure on small bodies of

water has been public demand for increased stocking with larger trout. This results in greater costs to the Utah State Division of Wildlife Resources and a more artificial fishery which is less popular with many anglers.

The projected population increase of 13,928 persons would result in approximately 4,200 new hunters and 3,900 new fishermen who would expend about 13,700 man-days of hunting and 15,000 man-days of fishing. These estimates are based on 1969 license sales (Rawley, 1972) in Kane County and per-capita rate of participation in these activities in Utah (Richardson, et al., 1966). A large portion of the increased hunting and fishing would occur within a 100-mile radius of the new town site.

By comparison, the present population of Kane County expended an annual estimated 2,400 man-days on hunting and 2,600 man-days on fishing in 1969. Habitat within a 100-mile radius of the proposed East Clark Bench town site is now hunted by about 11,000 deer hunters. The estimated 4,200 new hunters would therefore represent an increase of approximately 38 percent. Other types of hunting would be impacted similarly.

Populations of most wildlife game species in the affected area are already harvested at or near maximum levels for sustained yield management. Increased hunting pressure could be accommodated only by more restrictive controls, lower hunter success, and more crowded and competitive hunting conditions.

Adverse impacts on wildlife from outdoor activities other than legal hunting and fishing cannot be accurately quantified. However, it may be safely assumed that most of the estimated 4,200 new hunters and some of the nonhunting new residents would spend several days afield annually in other outdoor activities. In some instances loss of wildlife from poaching, disturbance and harassment equals or exceeds legal hunting kill. In southeastern Utah a decline in populations of desert bighorn coincided with the peak of uranium prospecting and mining activity in the 1950s.

Within the same 100-mile radius considered for legal hunting, an increase in off-road vehicle use of 40,000 man days annually has been projected (see recreation section). Even assuming that all new residents would be law abiding, conservation-minded citizens, some loss of wildlife productivity from inadvertent disturbance, and damage to habitat from increased erosion would be inevitable. This impact would be distributed over an area of about 30,000 square miles, based on a 100-mile radius.

Although many wild animals tolerate considerable human disturbance with little apparent reduction in numbers, some species are highly vulnerable. The reproductive period is the critical time for most and this is especially true of the large raptors. Repeated disturbance sometimes causes outright abandonment of nests. A more common and more subtle loss comes from increased predation and exposure of eggs to adverse temperatures. Each time a parent bird is caused to leave the nest the probability of loss to these hazards is increased.

Most species of small birds are sufficiently prolific that the overall population is not greatly affected by failure of a few nests. Large raptors, however, have low-reproductive capability. Some require 3 or more years to reach breeding age, commonly rear only one or two young at a time, and may not nest every year. A few additional nest failures each year is likely to ultimately lower populations of these species in an area by an indeterminable amount.

At its present level of productivity, Lake Powell could absorb the increased fishing use without undue loss of quality. However, any lowering of productivity or acceptability of the fishery for public use, that might result from accumulation of trace elements would reduce the capability of the reservoir to accommodate increased fishing demand. Trout waters of the small lakes and streams on Boulder Mountain and the Aquarius Plateau lack the capability to accommodate significant increases in fisherman use without deterioration in fishing quality. The existing high mountain trout fishery provides good quality

fishing. Many small mountain lakes can be reached only by hiking or backpacking and a high-quality back country experience is currently available. The high aesthetic quality of this type fishing would be lowered by increased use.

The 67-mile highway that would run from Glen Canyon City to Cannonville, Utah would permanently eliminate about 280 acres of diverse habitat. The approximate distribution by type would be; pinyon-juniper woodland, 87 acres; mixed shrub-grass scattered juniper, 55 acres; salt desert shrub-desert grass, 83 acres; riparian bottomland, 27 acres; barren, 28 acres. Wildlife losses associated with loss of these habitat types would be similar to those described for corresponding habitat in the plant, mine and new town sections.

Highways and access roads built for the project would probably stimulate construction of other roads with an accompanying increase in disturbance to wildlife. A large, rugged area such as Kaiparowits tends to remain relatively roadless because of high construction costs and limited economic incentive. However, once the area is penetrated by one or more improved roads construction of connecting roads to other points becomes more feasible.

Project effects on wildlife of the Kaiparowits Plateau impact area and surrounding area of secondary impact are summarized below:

Approximately 8,693 acres of terrestrial habitat would be lost or drastically reduced in productivity by structural features, quarrying, or by salt drift. About 3,956 acres of this loss would be habitat for deer, large predators including an occassional mountain lion, raptors, small birds and mammals, and reptiles. About 3,900 acres would be antelope habitat, and the remainder largely limited to sparse populations of small wildlife. Habitat losses by type are summarized in Figure III-47.

FIGURE III-47

Permanent Losses of Wildlife Habitat - Kaiparowits Plateau Impact Area and Limestone Quarry

Type of habitat	Acres of Habitat Permanently Lost to Structural Features								Acres altered by salt drifts in 28 years
	Plant site	Water pipe line	Mine	Aggregate sites & access roads	New town	Highway	Limestone quarry	Total loss to structures	
Barren Very little wildlife	-	100	-	15	-	28	-	143	
Pinyon-juniper woodland Wide diversity of wildlife species, deer, raptors, owls, perching birds, small mammals, large predator mammals including mountain lions	932	25	-	-	-	87	156	1,200	1,375
Mixed shrub-grass-scattered juniper Predator mammals except mountain lion, small mammals & birds, raptors, & reptiles, less diversity than pinyon-juniper	-	-	1,649	-	200	55	36	1,940	
Salt desert shrub-desert grass Antelope, rodents, lizards, raptors, coyotes	-	100	-	317	3,700	83	-	4,200	
Riparian bottomland Diverse wildlife, raptors, predator mammals, cottontails, perching birds, amphibians, important because of proximity to water or succulent vegetation	-	-	-	-	-	27	-	27	
Scattered ponderosa & bristlecone pine Winter range for deer & elk, sage grouse, raptors, predator mammals, small mammals and birds	-	-	-	-	-	-	48	48	

Populations of many wildlife species would be reduced an unquantifiable amount over an area of about 30,000 square miles by poaching, harassment, inadvertent disturbance and habitat deterioration resulting from increased human activity. Antelope would probably be eliminated from East Clark Bench.

Plant effluents and emissions would increase the probability that mercury concentrations in Lake Powell game fish would exceed the safe level for human consumption. This would cause lowered quality, or, at worst, possibly the complete loss of the sport fishery.

In all cases wildlife losses caused by elimination of habitat would be total and permanent. The common expression that wildlife is "displaced" or "moves to other areas" is not true. While displaced individuals may move to other areas, the other areas usually are already used to capacity or are unsuitable. Loss of habitat ultimately results in loss of wildlife, (Graham, 1944; Leopold, 1933; Moen, 1973).

Impact of habitat loss is not readily apparent in the case of highly mobile wildlife such as raptors and large predator mammals. Their individual ranges often extend far beyond affected habitat which would probably not be used full time anyway. However, the loss of any segment of habitat that produces some portion of the prey animals essential to predator existence ultimately results in some reduction in their overall numbers (Graham, 1944; Leopold, 1933; Moen, 1973).

Increased base load thermal generating capacity provided by the project would create a need for more peaking capacity, a portion of which would almost certainly come from hydroelectric power. Greater emphasis on peaking power at existing hydroelectric plants would result in greater water fluctuations with adverse impacts on fish and wildlife habitat. Construction of new hydroelectric plants would result in inundation of existing wildlife habitat and stream fisheries. This impact could occur far from the Kaiparowits project area and is unquantifiable at present.

Transmission system impact area

General impacts

Construction of the proposed transmission system would result in primary and secondary impacts on wildlife resources. Primary biological impacts would include actions that remove or destroy soil and vegetation. Vegetation in relation to soil productivity is the combination that produces food and cover for animals. Other primary impacts would involve physical destruction of dens and nests located in the soil or vegetation. Secondary impacts would include those resulting from increased human activity made possible because of new access. These would include increased legal and illegal hunting and disturbance and harassment of wildlife.

Major effects on deer and antelope would be the removal of existing vegetation and the increase of secondary successional vegetation. In some cases, secondary successional vegetation is preferred by mule deer and antelope, and wildlife species would probably increase their use along the proposed transmission line route. This increase cannot be predicted from available data. A long narrow strip of vegetation of an earlier successional stage would create "edge effect" that would benefit these two species. Negative impacts would include increased access for poaching and the aesthetic losses resulting from viewing wildlife against a background of transmission line facilities.

Desert bighorn sheep generally prefer climax grass vegetation with rough, isolated terrain. Little, if any, true climax vegetation remains in the southwest. However, some areas along the proposed transmission line routes retain a preponderance of grasses mixed with forbs and half-shrubs. This vegetative type is important to bighorn survival, and its removal would eliminate valuable forage for a considerable period of time. The climate, topography and soil in most desert bighorn range make revegetation difficult, and normal plant succession is usually slow. Indirect impacts would include: (1) Increased human

disturbance, i.e. human access into the desert bighorn sheep home range and increased hunting and poaching; and (2) The loss of aesthetic quality from man-made structures intruding into a relatively undisturbed habitat. Since lines would traverse such variable vegetative types it would be impossible to quantify expected decreases in bighorn sheep populations.

Removal or disturbance of existing vegetation and replacement by a lower successional stage might increase populations of some prey species utilized by large raptors and mammalian predators. If this were to occur, the impacts would be impossible to assess without determining factors presently limiting raptor and predator populations.

Towers and power lines provide excellent roosting and hunting perches for raptors. However, birds using these facilities suffer increased vulnerability to shooting. Increased access would pose similar problems with other species.

During the construction phase, daily and seasonal movements of animals might be blocked or interrupted. The more mobile species would probably not suffer appreciably but smaller animals with small home ranges would be adversely affected. Small animals may die if blocked from important parts of their habitat.

After construction, transmission lines would not be a significant barrier to animal movements although an occasional bird might fly into these structures during night migration.

Primary impacts of the proposed transmission line on small nongame mammals, birds and reptiles would be: (1) Outright killing of some individuals by construction and maintenance activities (mainly species unable to move quickly because of stages in their life cycle, or other factors, i.e. a snake or lizard sunning itself on a cold morning); (2) Alteration of habitat by removal or reduction of existing vegetation with subsequent increase of secondary successional vegetation depriving some species of essential food and cover.

Preliminary impact studies by Northern Arizona University of the Navajo project southern transmission lines indicated a decrease in small bird populations and their use of the disturbed areas because of removal of trees and ground cover. The same preliminary study indicates that some rodents might be favored by change to a lower successional stage of vegetation and would increase in numbers.

Secondary impacts would be continued road kills resulting from use of access roads by the public, and increased collecting, indiscriminate shooting, and inadvertent disturbance made possible by the roads.

Construction of the proposed transmission corridors would alter habitats occupied by the following endangered species: black-footed ferret, brown pelican, southern bald eagle, peregrine falcon, Vegas Valley leopard frog, Moapa dace, woundfin, Colorado River squawfish, Gila topminnow, humpback chub, bonytail chub, Colorado cutthroat trout, and possibly other, as yet unidentified species. Adverse impacts on those species would be the same as impacts discussed for other similar wildlife. However, local impacts would be of greater consequence to the species as a whole because of already reduced numbers or range. Most of these species have become diminished in numbers or range either because critical features of their habitat are already in short supply, or because they are especially vulnerable to man's activities. Therefore, alteration of a relatively small area of critical habitat or introduction of increased human activity could be a significant increment to an already adverse environment.

The proposed transmission line passes over the habitat of the Vegas Valley leopard frog in Las Vegas Wash. This is the only known location of this subspecies. Alteration of this specific habitat by removal, burning, or other alteration of vegetation, alteration of water quality or quantity, introduction

of toxic chemicals or petroleum products on the land or water or increased sediment load in the water, may further threaten or lead to the demise of this endangered wildlife species.

The impact of a wildlife species becoming extinct would be irreversible and permanent. That particular gene pool would be permanently lost as would future opportunities for scientific study of that species and whatever knowledge this might benefit man's understanding of his environment.

The proposed transmission line would affect endangered aquatic wildlife species through alteration of habitat. Some aquatic species require dense riparian vegetation and the present quality and quantity of free water. Removing riparian vegetation would limit the ability of some aquatic wildlife species to reproduce and occupy the area. Reduction of an aquatic species, should it occur, would result in loss of the scientific and aesthetic benefits provided by the species on that site.

Specific impacts

Figures III-39, -40, -41, show the total vegetation disturbance by vegetative type.

Impacts on big game

Primary proposal

Clearing of the transmission line in the pinyon-juniper and chaparral types would alter the vegetative type on approximately 2,240 acres of mule deer habitat of which approximately 530 acres are crucial (see Figure III-48). Alteration of the pinyon-juniper type on the Kaiparowits Plateau, Buckskin Mountains, and Coconino Plateau, Hualapai Indian Reservation, Cottonwood, Peacock and Hualapai mountains would increase "edge effect" and thus increase productivity of the mule deer winter range after native or introduced desirable vegetation

became established in 5 to 10 years. In other vegetative types, clearing of existing desirable browse would reduce carrying capacity of mule deer winter range in the area. The net impact after 5 to 10 years would probably be an increase in mule deer winter range carrying capacity. Removal of crucial mule deer winter range vegetation in the Beaver Dam Mountains would decrease mule deer on this range during the winter.

FIGURE III-48

Mule Deer Habitat Disturbed Along Primary Proposal

	Crucial habitat disturbed		Total habitat disturbed	
Area	Permanent acres disturbed	Temporary acres disturbed	Permanent acres disturbed	Temporary acres disturbed
Pinyon-juniper type	--	--	120	1,714
Beaver Dam Mtns.	15	35	15	35
Chaparral type in Arizona	2	160	2	160
Chaparral type in California	68	331	68	331
Total	85	526	205	2,240

Temporary alteration of 160 acres of chaparral in Arizona and 331 acres in California would decrease numbers of mule deer able to winter or exist year-long on these ranges during the first year or two after habitat alteration. However, within 4 years new growth would improve the habitat for mule deer and within 10 years the habitat would probably be back to its present production level.

Reproduction of mule deer and antelope could be reduced if construction occurs in the late spring and summer fawning season around Black Mesa, Perry Mesa Sycamore Mesa or Coconino Plateau in Central Arizona; the Beaver Dam Mountains in southern Utah and Virgin Mountains in northern Arizona and southern Utah; and the Santa Ana Mountains in southern California. Mule deer, elk and antelope would also be adversely affected if construction occurred while these species are on crucial winter ranges previously described.

The Perry Mesa mule deer herd in central Arizona, historically an excellent herd, has declined in recent years. A large part of this recent decline was caused by the construction road built for the Navajo project southern transmission lines. Efforts to block the access road have been ineffective.

Construction of approximately 20 miles of access roads would reduce the potential value of the Kaiparowits Plateau and the Beaver Dam Mountains in Nevada for desert bighorn sheep reintroductions.

Improved access and increased human activity would reduce numbers and productivity of desert bighorn on the east side of East Mormon Range, the south side of Mormon Range, the east side of Dry Lake Range, the west side of River Mountains, the west side of the Black Hills south of Railroad Pass, and the east side of McCullough Range, all in Nevada. The most critical areas would be the East Mormon Range, the Black Hills and the McCullough Range. There are no data for quantifying this impact.

The proposed corridor west of the Black Hills would disturb a critical open area migration route for desert bighorn sheep between the Black Hills and the McCullough Range. The proposed line would follow the normal migration route for 2 or 3 miles. Human disturbance of this critical migration might cause the desert bighorn sheep to stop moving between the Black Hills and the McCullough Range.

The major impact to desert bighorn in southern California would be development of access into the roadless Coxcomb Mountains that are crucial bighorn habitat. Other than the valley between the Black Hills and the McCullough Range in Nevada, the proposed transmission line route along the valley bottoms would have minimal effects upon desert bighorn sheep.

Northern Kaiparowits proposal

The main difference between the primary and this proposal would be reduced disturbance from the Coconino Plateau to Peacock Mountain south of the Grand Canyon and increased disturbance on the Buckskins and Beaver Dam mountains and Highland Range (see Figure III-49). The Beaver Dam Mountains are crucial mule deer winter habitat and construction of two transmission lines rather than one would increase the impacts along this route.

FIGURE III-49

Mule Deer Habitat Disturbed Along Northern Kaiparowits Proposal

Area	Crucial habitat disturbed: Permanent acres disturbed	Crucial habitat disturbed: Temporary acres disturbed	Total habitat disturbed: Permanent acres disturbed	Total habitat disturbed: Temporary acres disturbed
Pinyon juniper type	--	--	113	1,275
Beaver Dam Mtns.	24	58	24	58
Chaparral type in Arizona	2	160	2	160
Chaparral type in California	68	331	68	331
Total	94	549	207	1,824

The adverse impact of this route on bighorn sheep would be the same as for the primary proposal, and would result mainly from initial access into presently undisturbed or restricted access areas.

Increased losses of desert bighorn would occur on the Highland Range in southern Nevada because of improved access along the foothills of this range.

Arizona Strip proposal

The main difference between this proposal and the other two would be removal of an additional 310 acres of pinyon-juniper type along 24 miles (see Figure III-50). Multi-level pinyon-juniper vegetation type along the transmission line in the Arizona Strip supports more mule deer per acre than does the route through Beaver Dam Mountains. Removal of dense pinyon-juniper overstory may allow the understory to increase after 5 to 10 years and support more mule deer by increasing the "edge effect." Also, more water is available and there is a greater potential for water development along the Arizona Strip. These factors indicate why there is a significantly larger mule deer herd on the Arizona Strip than along the existing Navajo-McCullough line. Improved access into the Virgin Mountains would increase hunting and poaching of mule deer. Increased poaching would probably outweigh benefits of the limited "edge effect" created by pinyon-juniper removal. Such benefits are often temporary as pinyon-juniper usually reinvades the cleared area in 20 to 50 years. The adverse impacts, on the other hand, would persist indefinitely.

The Virgin Mountains contain relatively remote habitat that could potentially support desert bighorn. Increased access into these mountains might eliminate the potential for desert bighorn reintroduction.

Impacts on desert bighorn in the Highland Range would be the same as for the Northern Kaiparowits Proposal.

FIGURE III-50

Mule Deer Habitat Disturbed Along Arizona Strip Proposal

Area	Crucial habitat disturbed: Permanent acres disturbed	Crucial habitat disturbed: Temporary acres disturbed	Total habitat disturbed: Permanent acres disturbed	Total habitat disturbed: Temporary acres disturbed
Pinyon-juniper type	55	115	308	2,024
Chaparral type in Arizona	2	160	2	160
Chaparral type in California	68	331	68	331
Total	125	606	378	2,515

Impacts on other big game animals (all proposals)

Impacts on antelope, elk, white-tail deer, peccary, mountain lion and turkey would be similar to those previously discussed.

Impacts on upland game (all proposals)

Collision with conductors, towers, and static lines would kill or injure some upland game birds, especially migratory species, including mourning dove, white-winged dove, and bandtail pigeons.

In this arid region the combination of riparian vegetation and a perennial water supply provides a type of habitat quite limited in occurrence and crucial to survival of numerous wildlife species. Alteration or destruction of riparian vegetation such as along the Virgin, Muddy, Colorado, Verde, and Agua Fria rivers, and the Thousand Palms Oasis would cause loss of game birds. Due to the concentration of birdlife near these areas, loss of birds from striking power lines would be higher than most other places.

The proposed action would have no significant effect upon Gambel's quail east of the Beaver Dam Mountains. Providing access into Cedar Wash in the

Beaver Dam Mountains may allow people to destroy the guzzlers, which supply crucial water for quail. The remote quality of the area and the habitat would be destroyed. Poaching and destruction of quail guzzlers could increase along the east side of the East Mormon Range and Cedar Wash in the Beaver Dam Mountains.

The proposed transmission line and access road would alter habitat of chukar partridge, California quail, mountain quail, white-winged pheasant, desert cottontail, brush rabbit and black-tailed jack rabbit. Because these species prefer some sub-climax stages of vegetation, they would reinhabit the disturbed habitat when it reached the required stage of ecological succession.

Impacts on waterfowl (all proposals)

Waterfowl would suffer the same impacts due to the power line as discussed for migratory and upland game birds. Wintering waterfowl would be affected if construction occurs during the winter at or near the Verde River in Arizona, the Virgin and Muddy rivers in Nevada, and Thousand Palms Oasis in California. Waterfowl would be driven off by construction activity and forced to find other winter habitat in competition with other waterfowl.

Because of the land form and flight approach patterns to the Overton Wildlife Management Area, Nevada, waterfowl, shore birds and endangered brown pelicans may be killed or injured during migration if they hit transmission lines or towers along the proposed route north of Overton Wildlife Management Area and Lake Mead.

Impacts on nongame species (all proposals)

Should rodent populations along the corridor diminish with removal of the vegetation, rodents adapted to the altered environment would invade the disturbed area, thus virtually maintaining a status quo rodent population.

Nongame birds would suffer the same impacts from the power line as those discussed for migratory and nonmigratory upland game birds and waterfowl. Preliminary study of the impacts of the Navajo project southern transmission lines by Northern Arizona University indicated there would be an alteration in species composition and an overall decrease in numbers.

Impacts on raptors

Primary and Northern Kaiparowits proposals

Construction of the proposed transmission line through areas of high concentrations of nesting raptors may cause these birds to abandon the nest for that year. With endangered or threatened species such as peregrine falcons, prairie falcons, and southern bald eagle the adult birds may not return in future years to the same nesting territory. The most crucial areas are the Beaver Dam Mountains, Verde and Agua Fria rivers. These areas would be impacted if the line were constructed during the spring raptor nesting season.

Peregrine and prairie falcons are victims of a substantial illegal traffic in eggs and young. Therefore, increased access would have particularly severe impact on these species should any nesting sites occur near access roads.

Arizona Strip proposal

Because of the diversified multi-level vegetative association, the Virgin Mountains support high populations of small mammals that, in turn, support a high raptor population. Alteration of the pinyon-juniper association habitat and increasing "edge effect" would probably increase rodent and raptor populations.

Threatened and/or unique species (all proposals)

Mammals

The destruction of any habitat of the Stephen's kangaroo rat in San Jacinto Valley, California would further reduce habitat of this already rare

species. Recent investigating by Woodward-Clyde Consultants in September 1975 has identified previous work by J.R. Thomas in 1973, which theorize that only limited reinvasion of disturbed land by remnant Stephens' Kangaroo rat populations is taking place after the areas were allowed to return to their original state.

Should the black-footed ferret still exist in any prairie dog towns along the proposed route, it may be permanently eliminated from these areas by construction activities and post-construction human activities. It would be impossible to block an access road in the relatively flat terrain of the Navajo Reservation. Thus, if any of these secretive animals remain, they would be frequently disturbed by human activity and may not be able to survive.

Knowledge of the spotted bat is insufficient to determine whether the proposed transmission line would have any impact upon this rare species.

Birds

As discussed in the waterfowl section, brown pelicans may be killed or injured during migration while flying over transmission lines or towers along the proposed route north of the Overton Wildlife Management Area and Lake Mead.

Effects on the southern bald eagle and peregrine falcon would be the same as for the other raptors previously discussed.

Effects upon the mountain plover are not known at the present time.

Reptiles and amphibians

Impacts on the Vegas Valley leopard frog are discussed in the general impact section.

The proposed transmission line would increase access into Gila monster and desert tortoise habitat. This would increase the opportunity to see and collect these animals. Both species are slow moving and highly prized by collectors, thus the impact could be great.

Fishes

Impacts of transmission line construction through aquatic habitat have been discussed previously. The transmission line crosses over or parallels the Colorado, Virgin, Agua Fria and Muddy rivers which support the endangered Moapa dace, woundfin, Gila topminnow, the threatened Colorado River squawfish, and the protected Virgin spindace. Alteration of habitat or allowing fuel or other chemicals to enter live streams containing these species may lead to their demise.

Invertebrates and microorganisms

Preliminary conclusions reached by Northern Arizona University from studies concerning impacts of the Navajo project southern transmission lines on insects and closely related invertebrates (arthropods) indicate that destruction of vegetation reduced the number of these invertebrates. The proposed route parallels these lines to Phoenix.

Reptiles

Most reptiles are mobile and many would escape from the path of construction equipment. Others would be killed or injured, particularly species which may have retreated to dens or nests within the right-of-way. Loss of these individuals would cause immediate reduction in local populations but they would recover as other individuals invade the site following construction. Loss of habitat for species already rare, such as the flat-tailed horned lizard, the granite night lizard, and the Coachella Valley fringe-toed lizard would further reduce overall populations. Where all shrub growth would be removed, snakes might not readily reoccupy the area due to lack of shelter from the sun.

Reptiles are extremely vulnerable to professional and amateur collectors. In some flat desert plains and mesa areas where reptiles are one of the most successful animal groups, it would be extremely difficult to block off the access road. Therefore, greater numbers of reptiles would be collected, some illegally.

Proposed lines would increase access into desert tortoise habitat, allowing more people to see and collect these animals. When desert tortoise are denned up, they could be killed by heavy equipment or trucks passing over their dens.

Aquatic species

Aquatic animals of all types from simple protozoans and rotifers to complex amphibians and fishes would be killed if high concentrations of fuel, chemicals, or silt are introduced into water along the proposed route. Areas where this could happen are the Colorado, Little Colorado, Verde, Agua Fria, Virgin and Muddy rivers, Lake Mead, Lake Powell, Thousand Palms Oasis, various stock tanks, and the intermittent creeks and washes flowing into these rivers.

Impacts on wildlife at the eight new microwave sites are expected to be undetectable. No impacts would be expected at the existing developed sites.

Limestone quarry

The quarrying operation would eliminate 240 acres of diversified habitat supporting small populations of several species of wildlife including a few wintering mule deer and elk, and an occasional mountain lion. One of the more significant impacts would be the hazard to a nearby colony of Utah prairie dogs, an endangered species. Road construction, if not properly located, could eliminate the colony. Further hazards would result from increased traffic and human activity. The increased disturbance and harassment could cause loss of the colony even though roads were routed to avoid immediate vicinity of the colony.

Elimination or pollution of any nearby springs or seeps by withdrawal of ground water or by alteration of the watershed could cause more extensive losses to some wildlife than the actual quarrying operations. Increased traffic would cause increased road kills of most species of wildlife.

Permanent losses of habitat at the limestone quarry are summarized by type in Figure III-47.

Noise from the quarrying operation and transporting of limestone would have some local adverse impacts on wildlife. Numerous species of wildlife seemingly adapt to considerable noise and disturbance, particularly if occurring at the same place on a regular schedule. However, some of the more sensitive species probably would be eliminated from the immediate vicinity.

ECOLOGICAL INTERRELATIONSHIPS

Kaiparowits Plateau impact area

During the construction phase about 9,460 acres would be disturbed. Annual sediment production from disturbed sites would increase an average of 29 percent. Greatest sediment increase would occur on the power plant site, aggregate site and new community, which would be 38, 37, and 32 percent, respectively, with the least sediment increase being 11 percent along the water pipe line. Net annual sediment increase to Lake Powell during construction would be insignificant as it would be less than 1 percent greater than present sedimentation. As a matter of comparison, if vegetative cover is reduced by 2 percent by livestock grazing on 640 square miles of the Warm and Wahweap creek drainages, then theoretically the sediment would be increased by 0.01 acre-foot per square mile for an annual total of 6.40 acre-feet. The net annual increase to Lake Powell would be 1.7 percent or almost 3-1/2 times greater than the sediment deposition from construction of the generating station, access highway, aggregate sites, coal mine complexes and the new community. The sediment impacts to the Paria River drainage are considered insignificant as the increase would be less than 1/10 of 1 percent.

The combined effects of topsoil loss, increased soil salinity, and partial or complete removal of vegetation would have an adverse impact on the productivity of vegetation. A reduction in the total amount of vegetation produced would impact in a magnified way all animals that either feed on vegetation (herbivores) or animals that prey on the herbivores (carnivores). Herbivores and carnivores utilize vegetation at roughly a 10 percent level of efficiency. Removing or impairing the productivity of vegetation has severe impacts reflected in all animal life subsisting on the productivity of the vegetative cover.

The deer population would be reduced by an estimated 20 head year-long or 60 head during the winter as a result of salt drift on the vegetation and the physical occupation of deer habitat by man-made structures. Effects of sediments on the spawning beds of largemouth bass in Wahweap and Warm creek arms of Lake Powell cannot be properly evaluated due to the short history of the fishery there, and ever-changing habitat conditions as the reservoir continues to fill.

After construction is complete about 7,320 acres would be occupied by some type of man-made facility. Compared to present conditions, sediment production from the coal mine and power plant complexes would be reduced 74 to 37 percent per year, respectively. This is due to large areas that would be occupied by pavement and buildings. However, the highway segments along Nipple Creek, Wesses Cove, Pilot Knob, head of Tibbet and Wesses canyon would have an increase of 12 and 25 percent per year, respectively, in sediment production when compared to present conditions. This increase would be due to fragile soils and moderately steep slopes lying alongside the highways and access roads.

Such erosion could reduce productive capabilities of these fragile soils even further. The net decrease in sediment deposition in Lake Powell would be 0.14 percent per year under present levels. This very small decrease in sediment production probably would not adversely affect the flow of nutrients into Lake Powell that are needed for production of phytoplankton, a food source for fish and other aquatic species.

Nitrogen oxides (NO_x) and trace elements from stack emissions, once deposited in Lake Powell, could increase algae bloom to the detriment of fish and other aquatic species as oxygen in the water is depleted. How adverse or widespread a reaction the NO_x and trace elements would have on algae bloom or vegetation and soils is not known at this time.

The 1 foot of soil that would be placed on the fly ash-scrubber residue disposal site would be shallow enough to allow plant roots to come in contact with the residue. This residue material contains selenium and other heavy metal and trace elements and is not totally insoluble. Plant roots could absorb these trace elements and store them in vegetative tissue. Rodents and other grazing animals could then ingest the selenium and trace elements. The process whereby elements or compounds are increased in concentration as they are passed along the food chain (bioamplification) would then result. In the case of rodents and rabbits, which are a food source for birds of prey, trace elements would be passed on to the eagles and hawks residing in the area. Adverse effects of this cannot be predicted from available data.

Drift from cooling towers, containing salt, would adversely affect 1,375 acres within the immediate vicinity of the power plant. Each year after the power plant goes into operation, from 0.5 to in excess of 250 pounds of salt would be deposited per acre, depending on proximity to the cooling towers. Vegetation most sensitive to this salt accumulation would be sagebrush and pinyon-juniper, which are needed for deer food and cover.

After 50 years, sediment production from the salt deposition area would have increased 100 percent over present rates. However, there would not be an adverse effect on the spawning in Lake Powell because there would still be a net deficit of 0.52 acre-foot per year in sediment deposition when compared to present rates.

Pinyon-juniper trees averaging 500 to 700 years old, presently growing on the proposed power plant site, would be destroyed.

The coal mine operation could result in mixing of saline and fresh water aquifers. Also there is the possibility of drying up springs and seeps, particularly in Drip Tank Canyon, after the coal mine tunnels have been developed

and accumulated water pumped out of them. The drying up of springs and seeps would have a further effect on numbers of wildlife and grazing animals; to what extent is not known. Water is probably a limiting factor in large herbivore distribution in this area. Changes in water availability would result in direct changes in these herbivore populations.

The influx of 14,000 people into an area that has been relatively isolated would have a definite adverse impact on natural resources. Off-road vehicle use in remote fragile areas, where there are shallow soils on steep slopes, could increase annual erosion on some 30,000 square miles far in excess of present rates. Of particular concern would be the Last Chance drainage and possible effects on Lake Powell. Impacts on soil would be reflected in plant life and ultimately in animal life as described earlier.

Presence of motorized vehicles in remote canyons could inhibit bird of prey nesting and reproduction. Also the encroachment by recreationists and vehicles could further restrict deer habitat so the animals would be forced to exist only in inaccessible and remote areas.

Transmission system impact area

Soil and vegetation disturbance in the transmission areas could cause changes in living/nonliving relationships to the detriment of existing ecosystems. Exposure of soil through removal or destruction of vegetative cover would increase soil temperature and drying and adversely affect interrelationships of bacteria and microorganisms in the soil. This change would likely slow down nutrient cycles in the soil and affect productivity. Other changes in ecological interrelationships would be caused by construction of access roads, tower pads and communication sites. Effects of construction could be the blocking of washes or intermittent streams, removal of vegetation, increased surface erosion, reduction in soil moisture levels, crushing of animal dens, shelters, cavities and nests. The impacts would be death for some animals and their progeny, alteration of their habitat through reduced food and cover, and displacement from their home range.

Direct effects on flora would be crushing and removing of existing plant species. Impacts on flora would be a change toward lower stages of plant succession. A change in soil and soil microorganisms would be reflected by changes in higher life forms. The effect on microorganisms would be compaction of the soil and increased aridity. The impact on microorganisms would be reduced ability to inhabit the compacted and more arid soil. In general, the impacts would be a replacement of mature plant and animal communities with lower successional stages of plants and associated fauna.

Recovery rate of disturbed areas within the Mohave and Sonoran desert scrub vegetative association (see Vegetation section of this chapter) would be slow due to lack of moisture and in some cases shallow and low-productive soils (Figure III-51). This association supports several endangered floral and faunal species. Any surface disturbance in this association might eliminate crucial

FIGURE III-51

Vegetative Communities Recovery Rate Along the Proposed Transmission Line
(Assuming the present level of management)

Vegetative Association	Years Needed for Vegetative Community to Recover to 80-90% of Present Vegetative Association Level	Percentage of Vegetative Association along Primary Proposal	Percentage of Vegetative Association along Northern Kaiparowits Proposal	Percentage of Vegetative Association along Arizona Strip Proposal
Mohave & Sonoran desert scrub[a]	20 - 50	34	44	43
Great Basin desert scrub	5 - 20	26	25	20
Pinyon-juniper	20 -100	20	16	20
Grassland	5 - 10	13	8	12
Riparian & chaparral	5 - 20	7	7	5

[a]The vegetation would probably reach 80 to 90% of the predisturbance level in 20 to 50 years, but the surface condition would take many times longer to reach the same level.

habitat components for the Gila monster, desert tortoise, desert bighorn sheep and other protected, endangered or national interest animals. Surface disturbance may also eliminate Joshua trees, desert holly and other protected plants.

The Great Basin desert scrub provides food and cover for many wildlife game species (Figure III-51). Many of these are dependent at least in part upon a vegetative community in a subclimax condition. In this area, the disturbance effect of the proposed transmission line would benefit these animal species.

Effects of vegetative disturbance and removal of the pinyon-juniper vegetative association would be to set back the vegetation to a lower successional stage with related effects on wildlife dependent upon that habitat (Figure III-51). Small mammal and bird species associated with the pinyon-juniper type would be eliminated or reduced in numbers and those plant and animal species linked to lower successional stages of grass/forb or shrub types would increase or invade the area. Where climax vegetation is removed and the basic soil and productivity not impaired, the slow process of succession would be expected to occur. This process of returning to climax condition might involve several stages of plant and animal succession, depending on the site. Disturbance of communities presently in lower successional stages would result in less change and, other factors being the same, would be expected to return to predisturbance condition in a shorter period of time.

Because of increased moisture, riparian habitat is the most diverse vegetative association along the entire proposed route (Figure III-51). Due to the free water and multi-level vegetation, the animal diversity is also the greatest along the route. In addition, this habitat type is crucial for: (1) More animals classified as endangered; (2) more state-protected or rare animals than other vegetative associations. The endangered animals include the Moapa dace, woundfin, Gila topminnow, Colorado squawfish, southern bald eagle, peregrine

falcon, brown pelican and Vegas Valley leopard frog. The state-protected or rare animals include the Virgin River spindace and greater sandhill crane.

Disturbance or removal of the diverse vegetation in these riparian areas would reduce numbers and possibly the variety of these endangered and protected animals as well as numbers and variety of other song birds, waterfowl, shore birds, water-associated mammals, amphibians, fish and water-associated insects. For example, an Idaho stream channelization study revealed that channelization (habitat destruction) removed more than 90 percent of aquatic-dependent life along the disturbed area for more than 80 years (Gebhards, 1970). In areas of less precipitation, where water is more critical and limiting, destruction of an aquatic system may cause an even greater loss of fauna dependent on these systems.

Removal of water from streams, stock ponds, springs, and watering holes for use in construction of transmission line towers, watering of access roads or availability for the native animals, livestock and native plants has an adverse effect on life dependent upon that water. Cattle require 15 to 20 gallons of water per day, mule deer - 4 to 6 gallons, bighorn sheep - 3 to 6 gallons, and chukar require water twice a day. In the present situation, all existing free water in small streams or water holes is being used by either plants or animals. Any removal of this free water may eliminate the plants and animals dependent upon that water. (See Water Resources section of this chapter.) Water for drinking or the vegetation and insect life associated with an aquatic environment may be the limiting factor for survival. The limiting factor is that essential habitat requirement of a plant or animal population that is in short supply and limits numbers or distribution.

The chaparral vegetative association is the second most diverse vegetative and animal association along the proposed route (Figure III-51). Removal of

this vegetation would displace and probably eliminate birds, mammals, reptiles and insects presently dependent on the chaparral type. Because the chaparral vegetative type is a multi-level, highly diverse plant community, with a higher concentration and availability of water than in the surrounding area, the animal diversity and density is higher than neighboring areas where water is a limiting factor. Succession in this type back to chaparral is more rapid than it is in areas of greater aridity.

Impacts on ecological communities at the eight new microwave sites are believed to be exceedingly small. No impacts are expected at the existing developed sites.

Limestone quarry impact area

During construction and operational phases of the limestone quarry, a total of 240 acres would be affected. Sediment production from disturbed sites would increase by 31 percent during construction and decrease 53 percent during operational phase for a net decrease of 31 percent in sediment production in comparison with present estimates. The impact of the sediment changes on Piute Reservoir, located downstream, would be less than 0.03 percent and is considered insignificant.

The loss of 240 acres of vegetation could result in a loss of some 12 head of wintering deer. The greatest impact to wildlife would be to the nearby colony of endangered Utah prairie dogs as the increase of people and road construction could result in loss of the colony due to harassment and disturbance.

Blasting in close proximity to Tom Best and Reynolds springs could affect their discharge. Any appreciable decrease in discharge could result in a water shortage for wildlife and livestock causing them to leave the area. Any decrease in water from Tom Best Spring could create legal implications as its water is used for irrigation at Widstoe Junction.

The presence of 65 families in the area as a result of the limestone quarry operation could result in further harassment of wildlife and increased sediment production due to recreational and off-road vehicle uses.

Kaiparowits Plateau impact area

The greatest impacts are estimated to occur in the secondary influence zone (see Illustration II-30, Chapter II). This area was studied, and quantified impacts can be identified. In addition, hunting, off-road vehicle use, and other activities would impact a much greater area.

Impacts on paleontological resources

Impacts would be of two types: (1) direct from project-related construction activities; and (2) indirect from collectors and vandals who would gain access to new areas via construction roads. An additional factor would be the increase in local population related to construction and operation of the generating station and mine. The recreational use triggered by this population increase would bring about additional impacts.

No data exists on the scientific importance of the paleontological values in the areas of the proposed town site and highway system. Although no surveys have been conducted, paleontological values in adjacent areas indicate that similar values also occur in this region and that there is a potential for impacts on these resources.

In the area of Fourmile Bench, eight recorded sites of relatively minor scientific value would be disturbed or destroyed. One site containing fossil bones and fish scales would be directly affected by installation of evaporation ponds (Museum of Northern Arizona site number K-6). The construction access and haul road would directly impact a site containing fragmented dinosaur bones, fragments of turtle shells, reptile teeth, fish scales and gastropods (site K-3). The most important site, which contains a greater abundance of the above paleontological values (site K-1) as well as five other sites of lesser importance would be indirectly impacted as previously described (Breed, 1974). See Appendix III-11, Museum of Northern Arizona Report.

Most paleontological resources in the overlying strata of the coal mine would be lost or made inaccessible because of coal extraction or subsidence. Presently unknown surface and near-surface resources within the mine area and along the mine access road would be subject to direct impact from construction and mining activities over an area of approximately 1,814 surface acres. Subsurface resources in strata overlying the coal are unknown and would be subject to direct impact only in areas where mine shafts, air vents, etc. cut through the strata.

Impacts on archaeological resources

The proposed action would trigger two forms of impact on the prehistoric and historic archaeological resource base. Direct impacts would be most heavy and prevalent in the disturbance areas, while direct impacts in the secondary influence zone would be fewer and perhaps of less magnitude. Indirect impacts including family recreation, vandalism and artifact hunting would occur throughout the secondary zone on a long-term basis.

Some indirect impacts would be expected outside this zone. Indirect impacts in the secondary zone would initially occur where access is now available, and in areas made accessible by project-related roads. A general, but smaller, increase in indirect impacts is likely throughout the remainder of the area as recreational visits increase. Continuing and cumulative impacts of these forms of visitation would pose a serious threat to maintaining the archaeological record.

Archaeological data for the secondary influence zone is limited. Despite this, it is highly possible that an abundant and varied body of archaeological resources exists in the region.

Intermittent archaeological research in southern Utah outside the study area has been biased in favor of sites with architectural remains. These research efforts have not explored other patterns of human utilization for the area.

To a layman, most archaeological sites that would be impacted by the proposed action appear small and unimpressive; however, current anthropological theory and practice hold that sites of a less apparent nature cannot be understood apart from the total cultural system. Similarly, sites with architecture should be related to their total archaeological environment. To identify and quantify specific impacts to archaeological resources would require sufficient primary data in an appropriate theoretical framework to evaluate. At this time, these data do not exist.

Sites in the impact area are extremely fragile due to the many instances of organic preservation and the ease with which the numerous surface artifact scatters are damaged. On several occasions, sites recorded during 1974 were revisited. It was noted that since initial site recording certain types of artifacts have been illegally removed. With the proposed increase in construction activities in the area and the consequent boom in southern Utah's population, it is inevitable that continuous destruction of archaeological resources would occur by illegal recreational activities including artifact hunting, treasure hunting, and surface collecting. Off-road vehicular use also poses a threat. Many archaeological sites that would be impacted are presently undisturbed due to limited access. The optimal potential for understanding prehistoric activities through undisturbed surface artifacts is particularly threatened by the proposed action.

Generating station

Archaeological resources within the 6-1/2 square miles of the generating station and a 1/2-mile radius around it are subject to direct and indirect impacts from construction. Within this area, approximately 1,172 acres would be subject to surface disturbance from construction activities. Thirty archaeological sites have been recorded within the impact area and twenty within the 1/2-mile outlying

buffer zone. Two sites would be directly impacted by construction of the power plant and five others by associated facilities. The remaining sites would receive indirect long-term impacts contributing to their destruction.

New highway

Most surface and a portion of the near-surface archaeological resources occurring within the new highway right-of-way would be directly impacted by construction. Approximately 405 surface acres would be subject to disturbance from construction. Surface resources adjacent to the highway would be exposed to long-term indirect impact from persons and vehicles leaving the highway to disturb these sites. Until intensive surveys are completed, it is impossible to state the number of sites that would be directly and indirectly impacted.

Coal mine

Twenty-six archaeological sites have been identified within the proposed impact area and seventeen sites in the immediate adjacent areas. Since approximately 1,814 surface acres would be disturbed, direct impacts would involve two or three sites. The remainder would be subject to long-term indirect impacts.

Water pipe line

Construction of the water line and patrol road would disturb approximately 620 surface acres within the right-of-way area. Surface and near-surface resources in this area would be subject to significant impact. Archaeological sites immediately adjacent to the patrol road would be exposed to long-term impacts from persons and vehicles using the road. Until intensive surveys are completed, it is impossible to state the number of sites that would be directly and indirectly impacted.

New town

Approximately 5,000 surface acres would be subject to disturbance from construction of the town site. Archaeological sites within this impact area would be subject to destruction. Until intensive surveys are complete, it is impossible to state the number of sites that would be directly and indirectly impacted.

Removal of whole segments of an archaeological resource could seriously impair or prevent future opportunities for an unbiased scientific investigation of former cultural systems that operated within that region. Most cumulative impacts could be reduced through an increase in knowledge about a relatively unknown archaeological province. Creation of this data base represents a beneficial impact from the proposed action.

The authorizing agencies recognize their responsibility for compliance with the Historic Preservation Act of 1966 (Section 106) and Executive Order 11593 of 1971 (Section 2(b)). Data are lacking on the numbers and nature of specific cultural properties that might be impacted. Because of an incomplete determination of effect on sites that may be eligible for nomination to the National Register, it must be assumed that adverse effects would occur to those sites eligible for protection under Section 106/2(b). As a result, the Bureau of Land Management as the principal federal agency involved in the licensing of this project, is entering into a Memorandum of Agreement with the Advisory Council on Historic Preservation and the Utah State Historic Preservation Officer. This is as required by 36 CFR 800.5 (g) that detailed actions be taken to avoid or mitigate adverse effects where they can be applied. Such action is applicable only to those impacted areas where federal agencies retain control. Transfer of lands in the areas of the plant and new town sites would limit these controls.

Transmission system impact area

Introduction

Past life and human activities have left incomplete records in the form of fossils, sites, artifacts, structures, and other objects that provide partial clues for the reconstruction of life forms, adaptations, and events. Such data are unique, finite, perishable, and highly vulnerable. Potential impacts on the data base are all connected with the destruction, in part or in whole, of irreplaceable resources.

Paleontology - system-wide

Fossiliferous deposits occurring along the transmission line routes would be subject to both direct impacts from road and tower construction, and indirect impacts primarily from the actions of collectors and noncollecting users attracted by new access routes. Direct impacts would be expected in areas of surface and near-surface fossil-bearing material from grading for access roads and steel lay-down areas. Some direct impact could occur to subsurface fossils from drilling for tower footings.

Indirect impact would be expected primarily from possible exposure of new fossil beds because of grading or other surface work and also from collectors where access would be improved. Additional indirect impact to surface fossils adjacent to the transmission line routes would be expected from use of off-road vehicles, particularly near new road construction.

Impacts from surface disturbances or from vandalism could result in complete loss or destruction of scientifically valuable paleontological finds along the proposed system. After construction, access roads would probably be subject to long-term soil erosion and continuing fossil bed exposure because of continued use by maintenance and recreational vehicles. The greatest impacts would be expected along those portions of the proposed system without existing parallel transmission lines or access roads.

The overall impact to areas having invertebrate fossils would likely be minor because: drilling for tower footings would affect only a very small portion of any fossil-bearing deposit; surface and near-surface fossils are often weathered to the extent they have lost direct scientific value; a major portion of the transmission system would utilize existing access roads, thereby reducing the potential for new indirect impact and eliminating some direct impact from new road construction.

Potential disturbance to vertebrate fossil sites would be much higher since vertebrate remains are normally much more localized and much less common. Any such find can be considered of primary scientific importance.

A possible beneficial impact would be that construction-related exposure of previously unknown and unstudied fossil deposits could add to paleontological knowledge.

Archaeology

Archaeological resources along the proposed system would be subject to both direct impacts from construction activities and to indirect impacts from vandals and looters. All archaeological resources within the disturbance zone would be subject to direct negative impacts (partial or total loss). Indirect impacts would be expected adjacent to the rights-of-way, particularly where new roads must be built. Past experience has shown that any archaeological site in view of a public access road would be severely impacted by "relic" collectors and vandals. Off-road vehicles frequently range far from established roads, although their impact is greatest near roads. Recreational and off-road vehicles provide easy means of access to archaeological sites, and they are particularly destructive to scientific values of materials found in place on the surface.

Clearing of construction areas or any other direct modification of the surface during building of the transmission system would likely destroy irreplaceable

archaeological resources. The primary scientific value of artifacts or other archaeological remains is in their associations with one another and their physical surroundings, (i.e., context), rather than in the objects themselves. Any surface disturbance can be extraordinarily destructive to context and therefore to scientific data.

In general, impacts would likely be greatest in those areas within the system where present access is limited or difficult. Those proposed sections that follow existing access, while still carrying the potential for direct impacts to sites, would produce fewer indirect impacts.

Throughout the proposed transmission system, site inventory data are inadequate for accurate or complete evaluation and quantification of potential effects and impacts. Because potential damage and/or destruction are not limited to rights-of-way and areas of direct construction-related disturbance, it must be assumed that any site within an arbitrarily defined influence zone might suffer some damaging impact. For purposes of this discussion, the 2-mile wide corridor utilized for consultants' studies will be the influence zone considered. To an unknown extent, some indirect impacts resulting from new access could be expected well beyond these arbitrary "boundaries," just as there are probably sites within the 2-mile wide corridor that would remain safe from impacts.

The discussions that follow suggest the approximate minimum population of sites that may be present in the various transmission system proposals, and therefore subject to impacts as outlined above. No assessment of site size, type, time period, culture represented, or significance can be projected at this time, with the exception of those few areas where on-ground location and evaluation has been conducted. Similarly, probable severity of impacts to known or potential sites cannot be judged adequately at this time.

Primary proposal

Kaiparowits to Phoenix (see Figure III-52)

Museum of Northern Arizona measures of probable archaeological sensitivity when applied to controlled data from a comparable transmission corridor, suggest that a 2-mile square corridor segment with a "high" sensitivity ranking might be expected to yield an average of 1.67 sites, with 0.7 and 0.54 sites for "moderate" and "low" ranked segments (Chapter II, Figure II-49).

These averages were applied to the untested and/or spot-checked segments (converted from "links") of the proposed Kaiparowits to Phoenix route. From these averages it is projected that 122 sites might be expected to occur within the proposed corridor. It should be noted that the proposed Kaiparowits to Phoenix corridor enters areas geographically and culturally unlike the control area (Southern California Edison/Arizona Public Service Moenkopi to Eldorado), and probability values might be significantly different as a consequence. Also, it should be borne in mind that probability figures are not "real" numbers, and that data projection of this sort does not take the place of intensive on-ground survey. Sites would need to be located, evaluated, and appraised in terms of the proposed action before direct impacts could be assessed. It can be assumed that at least this number of sites might be vulnerable to indirect impacts.

Kaiparowits to Eldorado

The Arizona and Utah portions of this proposed route were similarly ranked by the Museum of Northern Arizona (Chapter II, Figure II-50). Control averages applied to these rankings suggest that approximately 59 sites might occur within the corridor in Arizona and Utah. The same cautions noted for the Kaiparowits to Phoenix corridor evaluation also apply here. The Nevada portion of this proposed route includes a minimum of 54 identified sites. Again, on-ground work is needed to evaluate specific impacts to specific sites. (See Figure III-53.)

FIGURE III-52

Probabilities of Archaeological Sites on Kaiparowits to Phoenix Corridor Based on Sensitivity Ratings and Controlled Sample ("Links" Converted to "Segments")

Rank	Number of Segments	Control Average Number of Sites/Segment	Anticipated Number of Sites	Est. Prob. at Least One Site	Anticipated Number of Segments	Est. Prob. Two or More Sites	Anticipated Number of Segments
High	25.6	1.67	42.8	0.78	19.9	0.22	5.6
Moderate	101.9	0.70	71.3	0.30	30.6	0.18	18.3
Low	25.3	0.54	7.8	0.31	7.8	0.11	2.8
Totals	152.8		121.9		58.3		26.7

FIGURE III-53

Probabilities of Archaeological Sites on Kaiparowits to Eldorado and Moenkopi to Mohave Corridors Based on Sensitivity Rankings and Controlled Sample

Rank	Number of Segments	Control Average Number of Sites/Segment	Anticipated Number of Sites	Est. Prob. at Least One Site	Anticipated Number of Segments	Est. Prob. Two or More Sites	Anticipated Number of Segments
High	32	1.67	53.4	0.78	25.0	0.22	7.0
Moderate	109	0.70	76.3	0.30	32.7	0.18	19.6
Low	30	0.54	16.2	0.31	9.3	0.11	3.3
Totals	171		145.9		67.0		29.9

Kaiparowits to Moenkopi to Mohave

From Moenkopi substation westward, approximately half of this proposed route follows the alignment of the Moenkopi to Eldorado corridor used by the Museum of Northern Arizona as a control, and the remainder covers comparable terrain, so that extrapolations from the controlled data to the proposed route are probably the most reliable among the three routes so treated. Rankings on this proposed route (Chapter II, Figure II-51) suggest that 87 sites might be expected within the corridor between Moenkopi substation and the Arizona-Nevada border. The Kaiparowits to Moenkopi section of the route is considered the same as the like section of the Kaiparowits to Phoenix proposal. As before, on-ground work would be required before specific impacts could be determined. (See Figure III-53.)

Mohave to Serrano

The five sites identified along this proposed route by University of California-Riverside archaeologists represent only a partial sample of the corridor. More sites might be located by a more complete survey, but it was the consultants' appraisal that the proposed route would probably cause less impact to archaeological values in general than would other potential routes through the California desert (Barker and Schlanger, 1974). The sites located are quite vulnerable to disturbance, and several are judged to be of National Register caliber. Kind and severity of impacts to specific sites have not been fully evaluated.

The rock art sites located by Ike Eastvold are believed by him to be threatened by indirect impacts. Eastvold feels that the intrusion of transmission lines, which would be visible from at least five of the sites, would substantially change the character of the setting, perhaps to the extent that their National Register inclusion potential would be lessened.

Northern Kaiparowits to Mohave preferred alternate

Most of this proposal would follow the same corridor as the proposed Kaiparowits to Eldorado route. Because of the increased disturbance of a second line, however, impacts might be somewhat greater than those projected for the Kaiparowits to Eldorado single line. Additionally, this proposal includes a section from Eldorado to Mohave, on which two sites have been located.

Arizona Strip preferred alternate

This proposal would create unbroken east-west access across a broad area where the few existing roads are generally north-south and infrequently interconnecting. This area is also very sparsely populated. Because of these conditions, archaeological remains are among the least disturbed in the nation.

The few archaeological studies that have been performed in the Arizona Strip indicate that high site densities and uncommon preservation values can realistically be expected to occur along the proposed route. Comparison of this proposal with the Kaiparowits to Eldorado (or Northern Kaiparowits to Mohave) proposal, both in terms of access and site densities, "indicates a significantly higher potential impact on archaeological resources along the route of the proposed Arizona Strip alternate alignment than might be expected along its northern counterpart" (Hunt and McPherson, 1975:10).

Because of the present lack of available access to areas that would be opened by construction of a transmission line through this area, it is expected that direct, and especially indirect impacts to archaeological resources might be the most severe of any section of the proposed transmission system.

National Register and Register-eligible properties

State Historic Preservation Officers in the four states involved in the proposed transmission system were asked to evaluate effects and potential impacts

on archaeological sites known to occur within the vicinity of all proposed and alternate routes. State Historic Preservation Officers are required by provisions of the National Historic Preservation Act of 1966, Executive Order 11593, and 36 CFR Part 800 to assess the effect of federal or federally-sanctioned actions on sites, districts, and other remains eligible for protection. Responses are summarized in Figure III-54.

One of the two National Register of Historic Places sites enumerated in Figure III-54 is on a proposed alternate route. This is the Winona site, near the proposed Pinnacle Peak alternate east of Flagstaff. The historic Modjeska House, in Orange County, California is discussed in the following section.

FIGURE III-54

Known Archaeological and Historical Sites and Districts in Vicinity of Transmission System (including alternates) Identified by State Historic Preservation Officers

	Recorded Sites, Points of Historic Interest	State Register Sites Historic Landmarks	Potential National Register Sites[a]	National Register Sites[b]
Arizona		16	15	1
California	4	12	8	1
Nevada	54			
Utah	(No data provided on transmission lines)			

[a] Includes sites currently nominated to, or considered worthy of nomination to, the National Register of Historic Places, and protected under Section 2 (b) of Executive Order 11593. Non-Register sites listed have not been evaluated in terms of National Register criteria and may be eligible for inclusion.

[b] Protected under Section 106 of National Historic Preservation Act of 1966.

Archaeological sites and districts nominated to the National Register on the proposed routes are the Perry Mesa and Calderwood Archaeological Districts, and Antelope Cave. The Perry Mesa District, already impacted by transmission line development, would suffer from additional disturbance. Direct impacts from construction might be heavy, and indirect impacts from vandals, looters and off-road vehicle recreationists would also be high in this area of unusually high density and archaeological importance. The Calderwood District, near the Westwing terminus of the Kaiparowits to Phoenix proposal, is endangered at present by urban expansion and related developments in the Phoenix area. It would additionally be subject to the same sort of impacts as the Perry Mesa District. Antelope Cave would be subject to indirect impacts from increased visitation during construction in spite of physical measures made to protect it.

Potential direct and indirect impacts of the transmission system on archaeological resources are high. A probable beneficial impact is that new information would be added to archaeological knowledge as a result of intensive survey and salvage excavations. Loss of unrecovered data and losses to the resource base, however, would probably outweigh this benefit.

History

Potential physical impacts on historical values would be much the same as for archaeological values, with direct impacts stemming from construction-related surface modifications, and indirect impacts from increased access and vehicle traffic. Additionally, historic features might suffer appreciably by a modified setting and loss of historic integrity from the presence of transmission lines, towers, and access roads.

Several historic features within the proposed system are included in, nominated to, or considered potentially eligible for the National Register of

Historic places. Two trails (Dominguez-Escalante and Old Government Road) figure in 1976 Bicentennial interpretive activities.

Mining camps, ghost towns, and abandoned homestead sites, frequently accessible only by jeep trails, dot segments of the transmission system, especially in northern Arizona. Although known historic sites of this kind are accessible at present, increased or easier access could accelerate visitation and vandalism. Growing interest in antiques of any description, and the mushrooming increase of bottle collecting hobbyists in recent years make any isolated historic locale vulnerable to partial or total destruction. Those sites that have been violated little in the past because of remoteness are likely to suffer most as access is improved.

Primary proposal

Kaiparowits to Phoenix

This proposed route would cross several features of historic importance, including the Sitgreaves Route, Whipple Route, and Beale Route. Each of these would be crossed in the vicinity of U.S. 66 in the Kaibab National Forest. Extent of physical or aesthetic impacts would probably be slight because of prior disturbances to their integrity.

Kaiparowits to Eldorado

This proposed route would cross the Dominguez-Escalante Trail, Spanish Trail, Old Mormon Immigrant Trail, Navajo Trail, Honeymoon Trail, and Temple Trail. The Honeymoon Trail and Temple Trail have been nominated to the National Register of Historic Places. The Spanish Trail and Old Mormon Immigrant Trail would be crossed in numerous locations where the proposed line closely parallels their course. These two trails are also paralleled or crossed by Interstate 15 and U.S. 91. Impacts of construction on these historic trails have not been adequately determined.

Kaiparowits to Moenkopi to Mohave

The Moenkopi to Mohave section of this proposed route would pass near the Moqui Stage Station, a site presently nominated to the National Register of Historic Places. The station could suffer considerably from increased visitation. Trails crossed would be the Beale Route and Sitgreaves Route, each in two locations.

Mohave to Serrano

This proposed route would cross the Old Government Road and the Whipple Route. A major impact would be on historic Camp Young. The proposed route would travel along the northwest edge of this World War II training area. In the Chiriaco Summit area the route would cross another section of the camp. These intrusions would appreciably lessen historic integrity and aesthetic values in both sections. Interpretive values could be influenced by construction activities. In general, potential impacts on this interesting historic site appear significant.

Modjeska House, a National Register historic site in Orange County, is located several miles south of the proposed route, and does not appear to be subject to effects or impacts of any kind arising from construction of the line.

Northern Kaiparowits to Mohave preferred alternate

Known historic features potentially affected by this proposal are the same as those listed for the Kaiparowits to Eldorado proposed route.

Arizona Strip preferred alternate

This proposal would intersect the Dominguez-Escalante Trail, the Navajo Trail, and Temple Trail. Because of the relative remoteness of the locations, disturbances to the historic integrity of these trails might be greater than those caused by other crossings in more disturbed areas.

Determination of adverse effect

The authorizing agencies recognize their responsibilities under requirements of the Historic Preservation Act of 1966, Section 106, and Executive Order 11593, Section 2 (b). Because of insufficient data on the number and nature of specific archaeological and historical properties subject to impact, and because of incomplete determination of effect on sites that may be eligible for National Register inclusion, it must be assumed that adverse effects to sites eligible for protection under Section 106/2(b) would occur. Consequently, the Bureau of Land Management, as the principal federal agency involved in the licensing of this project, is entering into a Memorandum of Agreement with the Advisory Council on Historic Preservation and with the Arizona, California, Nevada and Utah State Historic Preservation Officers, as required by 36 CFR 800.5 (g), detailing actions to be taken to avoid or mitigate adverse effects. Specific measures are included in Chapter IV as BLM mitigating measures.

Limestone quarry impact area

Paleontology

Intensive paleontological studies have not been completed for the limestone quarry. The fossil sites noted in extensive surveys of the area are of little scientific significance but are subject to total destruction. The losses to future scientific assessments are not considered important.

Archaeology

The 18 archaeological sites within the impact area would be subject to direct impacts and total destruction by mining or other development. Preliminary surveys on exploratory drilling sites indicate that artifacts consisting of chipped stone material occur and would be subject to destruction.

Better access, as a result of the proposed quarry, could encourage an influx of people interested in artifact hunting and collecting. This could result in pilfering or destruction of significant sites and their subsequent loss to scientific interpretation.

RECREATION

Kaiparowits Plateau impact area

The direct impacts from the proposed actions are as follows:

Cultural values

The only cultural site having significant recreation value that would be directly impacted by the proposed actions is the Navajo Trail. Development of the new town on East Clark Bench would destroy the historic integrity of the trail. The magnitude of the impact cannot be assessed because the historic significance of the trail is not known.

Natural values

Removal or disturbance of vegetation and wildlife would not appreciably affect recreation use in the Kaiparowits Plateau impact area. Vegetation would be disturbed or removed on approximately 9,460 acres during construction, while approximately 7,320 acres would be permanently occupied by improvements. An additional 1,375 acres of vegetation could be lost due to heavy salt fallout from the cooling towers (see Figure III-19 in Soils section for details). A resulting loss in wildlife dependent on this vegetation would occur. Thus, opportunities for viewing the vegetation and wildlife would be lost for the life of the project. With one exception, vegetation and wildlife that would be impacted are not particularly unique and the loss in recreation use values would be very small. The exception is the pinyon-juniper stand on Fourmile Bench. This stand was noted as being an outstanding example of mature pinyon-juniper forest in a study (Environmental studies-1974) conducted by Brigham Young University. Approximately 50 percent of this stand could be removed or disturbed by construction or salt deposition. With no change in access it is doubtful this area would be a significant recreation attraction. However, with the proposed new highway to be located adjacent to the area it could become a high use recreation attraction.

Recreation use that would be foregone as a result of the removal of vegetation and wildlife would be negligible. Approximately 10 hunter-days annually would be lost.

The mercury and nitrates (conversion products of nitrogen oxides) emitted from the plant could affect fish populations in Lake Powell as could the concentrated salts in tailings ponds if allowed to enter the lake. See Wildlife section for a more detailed discussion on probable impacts of these substances on the fish population.

The impact on geologic features having recreational value would be minimal. The only significant geologic formation directly impacted by the project is the Cockscomb near Grosvenor Arch. The proposed new highway and the proposed Utah Power & Light Co. power line (see Illustration I-2, Chapter I) would cross the Cockscomb at that point. An electrical substation is also proposed for development in close proximity to the arch. Many thousands of additional tourists would have an opportunity to view Grosvenor Arch and the Cockscomb. However the quality of the recreation experience would be reduced because of the visual presence of the new highway, power line and substation (see the Aesthetic Section for additional information on impacts.) The generating station would occupy an area of 932 acres on which there is a small quantity of low quality petrified wood.

Primitive-wilderness values

The proposed developments would not directly impact primitive and roadless areas identified in Chapter II. However, the "back country" within the Kaiparowits Plateau impact area would be impacted. The system of new roads, the plant complex and the mining complex would essentially ruin the area for "back country" recreation use. However, it is estimated that less than 1 percent of the land available (within a 100-mile radius) for "back country" use would be lost due to project development.

All areas having primitive values would be affected by indirect impacts. The Paria Canyon Primitive Area, Hackberry Canyon Roadless Area, Fifty Mile Mountain Roadless Area and primitive values in the Glen Canyon National Recreation Area are particularly vulnerable to heavy use because of their proximity to the proposed new town site and major travel routes. Heavy use and acts of vandalism could result in the destruction of vegetation, marring or destruction of geologic features, and deterioration of the quality of the wilderness. Research has shown that "general overuse and congestion are major sources of (visitor) dissatisfaction" in primitive areas (Lime - 1975).

Expected increase in off-road vehicle (ORV) use could adversely impact all areas having primitive value, including the Escalante River drainage. Off-road vehicle use can lead to destruction of plant life. The vehicles create tracks that destroy the pristine character of the environment and often cause accelerated erosion, creating ugly scars on the landscape.

Aesthetics

The actions proposed by the applicants would significantly affect the existing visual environment. Magnitude of the impacts would be reduced somewhat by the fact that the major visual intrusion (i.e. generating station and mine area) would be located in areas of low to moderate scenic quality (see Illustration II-51, Chapter II). The intrusions would also be concealed from major existing travel corridors. However, the proposed new highway would provide close-up exposure to these major intrusions. Heavy tourist traffic would likely occur on the new highway for the following reasons:

a. The distance between Bryce Canyon National Park and Glen Canyon National Recreation Area would be shortened by 51 miles via the new highway.

b. The new highway would shorten the route for tourists coming south to Glen Canyon National Recreation area from upstate Utah by 23 miles.

c. Both Bryce Canyon National Park (431,000 visitor days-1973) and Glen Canyon National Recreation area (1,209,000 visitor days-1973) are major tourist destinations that tourists would likely plan to visit in the same trip (100 miles apart via proposed new highway).

Visual impacts from the proposed physical improvements (i.e. structures, vegetation modification and landscape modification) are shown in Figure III-41. Impacts are assessed for all important view areas from which proposed modifications would be visible. The following descriptions are provided to assist the reader in interpreting the information in Figure III-55.

Viewers Position: A point such as an overlook or line segment such as a segment of highway from which modifications proposed by the participants would be visible.

Landscape modifications visible from the viewer position: Structures, vegetative modifications or landscape modification proposed by the participant that would be visible from the viewer position.

Visual vulnerability: The visibility of an area from a specific viewer position based on distance and aspect of slope (see Illustration II-52, Chapter II).

High vulnerability: Areas visible within 0-5 miles and vertical-facing slopes up to 10 miles.

Moderate vulnerability: Areas visible between 5 and 10 miles distance.

Low Vulnerability: Unseen areas or visible areas beyond 10 miles.

Scenic quality: The relative quality of the scenery in the area of the modification compared to other scenery in the region (see Illustration II-51, Chapter II).

Visual contrast of modification: The rating is in terms of degree of contrast (i.e. weak, moderate and strong) of the modification with the existing

FIGURE III-55

Aesthetic Impacts
Kaiparowits Plateau Impact Area

Viewer position	Landscape modifications visible from viewer position	Visual vulnerability	Scenic quality	Visual contrast of modification	Degree of impact for each modification	Degree of impact (cumulative)
Lake Powell-Warm Creek Bay (looking northwest)	1. Berm surrounding pump station.	H	VH	L	L	
	2. Two power lines from toe of slope to top of Nipple Bench.	H	H	L	L	L
	3. Microwave tower-top of Nipple Bench.	H	H	M	M	
Wahweap Marina (looking north)	(No modifications visible)					
Bryce Canyon National Park Rainbow Point Overlook (looking southeast)	1. New highway	L	L	L	L	L
	2. Generation station	L	L	L	L	
U.S. 89 near Glen Canyon City (looking northeast)	1. New Town site-East Clark Bench	H	L	M	M	M
	2. New highway Nipple Creek	M	M	M	M	
	3. Marshalling yd & Const.camp	H	L	H	H	
Warm Creek Road at Junction with pipeline (looking north & south)	1. Scar from pipe line	H	L-H	M	M	
	2. Service road	H	L-H	M	M	
	3. Two power lines from toe of slope to top of Nipple Bench.	H	L-H	H	H	H
	4. Temporary pipe line power line	H	L-H	H	VH	
	5. Microwave tower-top of Nipple Bench.	H	H	H	H	
View from new highway in vicinity of Grosvenor Arch	1. Cuts & fill of new highway as it passes over Cockscomb.	H	H	H	H	
	2. Power substation	H	L	H	M	H
	3. UP&L power line	H	L-H	M	M	
View from highway at Crest of Cockscomb (looking southeast)	1. New highway	H	L-M	M	M	
	2. Generation station	L	L	L	L	M
	3. UP&L power line	H	L-M	M	M	
View west from highway (Longflat to Cockscomb.)	1. Microwave site	H	M-H	M	M	M

FIGURE III-55 (concluded)

Aesthetic Impacts
Kaiparowits Plateau Impact Area

Viewer position	Landscape modification visible from viewer position	Visual vulnerability	Scenic quality	Visual contrast of modification	Degree of impact for each modification	Degree of impact (cumulative)
View southeast from new highway (Cockscomb to Fourmile Creek)	1. New highway	H	L-M	M	M	M
	2. Generation station	L	L	L	L	
	3. UP&L power line	H	L-M	M	M	
View southwest from new highway along Fourmile Bench	1. Generation station complex	H	L	H	H	H
	2. New highway	H	L	M	M	
	3. UP&L power line	H	L	M	M	
View from new highway along Wesses Canyon	1. New highway	H	M	H	H	H
	2. Pipeline & conveyor system	H	L-M	H	H	
	3. UP&L power line	H	L-M	H	H	
View south and east from new highway along John Henry Bench	1. Coal mining and preparation facilities	H	L	H	H	H
	2. Water pipe line facilities	H	L	M	M	
	3. Transportation facilities (i.e. roads, conveyors, power line	H	L	H	H	
	4. Central administration complex	H	L	M	M	
	5. Waste facilities	H	L	H	H	
	6. New highway	H	L	L	L	
View south and east from new highway along Nipple Bench	1. Water pipe line including two power line and service road.	H	L	M	M	M
	2. New highway	H	L	L	L	
View from new highway along Nipple Creek	1. New highway	H	M	M	M	M

LEGEND
Very high - VH
High - H
Moderate - M
Low - L

environment. The elements of form, line, color and texture are evaluated for contrast. The rating is designed to determine the relative ease with which deviation (or modification) can be seen.

Potentially, the most severe visual impact to the area, and possibly to the entire region, could be caused by airborne pollution emitted from the plant. Two types of visual impacts could result from these air pollutants.

First, the distance one can see could be substantially reduced (see the visibility portion of the Air Quality section). Visibility in the scenic region of southern Utah and northern Arizona could be reduced by 10 to 20 miles, which would be an adverse affect on the viewer's perception of the open characteristics of the landscape and negate the more distant topographic features. A study (Betchel Power Corporation-1974) sponsored by the participants indicates that reduction of visibility of this magnitude (i.e. 10 to 20 miles) would occur infrequently.

Second, coloration of pollutants could alter the natural coloration of blue sky and particularly affect the contrast of scenic topographic features against the skyline. The degree of impact would depend on the viewer's position in relation to the plume.

Should any of the pollution control equipment malfunction there would be a possibility for severe visual impacts. There would be a good possibility that dense visual air pollution would drift into outstanding scenic areas such as: Bryce Canyon National Park, Glen Canyon National Recreation Area, Dixie National Forest, Kaibab National Forest, Grand Canyon National Park, Zion National Park, Capital Reef National Monument, Monument Valley and many other highly scenic areas.

The greatest potential visual impact would likely occur at Bryce Canyon National Park. The plant would be visible from most of the park overlooks. Visual

impacts would range from low to very high. If only the plant structures are visible, the impact would be low (see Figure III-55 view from Rainbow Point), since the plant would be 32 air miles from the nearest overlook and would be backgrounded by the Smoky and Fifty-Mile mountains. However, if a stack plume is visible or a haze condition develops from the stack emission which would obscure landscape features and detract from the natural beauty of the area, the visual impact could be very high. Other conditions which may contribute to the high impact are the lights at the plant (i.e. strobe lights on the stacks during daylight hours and vehicle and plant lights at night) and reflections from vehicle and plant windows or other reflective materials. The probable frequency and magnitude of occurrence of a visible plume or haze are not well defined, as indicated in the air quality section of Chapter III. If the pollution control equipment operates at design efficiency it is highly unlikely there would be a visible plume. However, technology is not as far advanced for controling the yellow discoloration (haze) associated with nitrogen oxide emission. Hence the probability for haze is greater. Again, the probable magnitude and frequency are not well defined. Observations at other generating plants having similar pollution control equipment as that proposed at Kaiparowits are mixed. A yellow discoloration has been periodically observed for the first Navajo unit and has deepened with the start up of the second unit. The experience at the San Juan and Huntington plants seems to be better. The potential does exist for periodic high visual impacts due to visible plume or haze conditions resulting from stack emissions.

Should a haphazard "boom-town" situation be allowed to develop at the proposed new town site on East Clark Bench, a serious, long-term visual impact could occur. To a certain extent, this situation already exists at Glen Canyon City. Even if orderly, aesthetic, well-controlled growth occurs, there would be a significant impact in that views of scenic cliffs to the north could be partially

obscured. Also the natural setting could be essentially destroyed. The marshalling yard and construction camp proposed near Glen Canyon City could have a high visual impact over the 10-year life of that phase of the project.

Indirect impacts

An increase of population in the area would create indirect impacts to recreation facilities, present uses and resources. Impacts resulting from the need for community recreation facilities and programs are discussed in the socioeconomic section.

Marina facilities at Wahweap are likely to be most heavily impacted. Recreation facilities at Wahweap are currently operating at or above capacity during busy weekends. The projected increase in tourism (see Figure II-54, Chapter II) would place a severe strain on existing facilities and areas. If the impact from 13,928 projected new residents would be added to this, existing facilities could not handle the increase.

To illustrate the possible magnitude of this impact, some basic assumptions are made: (1) as a result of the proposed project, population in close proximity to the Wahweap area is projected to increase 13,928, which is about double the present population; (2) this would be an increase of approximately 3,270 heads of households; (3) if 30 percent of these households owned boats (approximate ratio in Page at present); and (4) if 50 percent went boating on Lake Powell during a busy weekend, this would constitute an increase of over 500 boats.

The Wahweap boat ramp and parking facilities are not capable of handling anywhere near this increased use. New marina facilities would have to be developed. Ranger and maintenance staff would have to be increased to provide visitor protection and enjoyment. Other implications of increased use would be safety problems created by increased use of Wahweap and Warm Creek bays and diminishing of the quality of experience for boaters who seek solitude in nearby canyons and bays. Also there would likely be an increase in vandalism at the recreationally-significant archaeological sites in the side canyons of Lake Powell.

Major impacts could result from increased off-road vehicle (ORV) use. It is estimated the 50 percent (assuming the ORV ownership would be similar to Page, Arizona) of the new households would have some type of ORV, i.e. motorcycle, dune buggy, four-wheel drive vehicle, or pickup truck.

It is estimated that an area of 100 miles in radius would be impacted by ORV users. This is based on a study (The Recreation Vehicle in California-1974) that indicates ORV users are willing to travel 1.3 hours to reach a destination for a 1-day trip and an average of 3.6 hours for a 2 or 3-day trip.

The volume of use is estimated at approximately 40,000 visitor days annually based on the following assumptions:

a. 1,635 households owning ORVs.

b. Participation rate of 2.05 trips per month (Peine-1972).

c. An average length of stay of 6 hours.

d. An average party size of two.

The pattern of use and impacts would vary with the type of ORV user. The ORV user can be classified into three types (Peine-1972):

a. The vehicle-oriented user.

b. The activity-oriented user.

c. The land-oriented user.

It is assumed that all three categories would be equally represented by the new residents.

For the vehicle-oriented user, operation of the vehicle is an end in itself. For him, the landscape is a place to evaluate vehicle performance. This type user frequently inflicts the greatest damage on the landscape by forcing the vehicle up steep sidehills and ridges. Heavy use of this nature is expected to occur around the town sites and near major travel ways.

The activity-oriented user primarily perceives the landscape as a place to pursue his interests such as a hunter who drives his vehicle into the back-country in search of game, an amateur prospector in search of minerals, or a rockhound looking for gems. He is more likely to follow existing trails but will leave the trail if necessary to reach his destination. Impacts from these users are more likely to be: Looting of antiquities, marring or destruction of historic values, destruction of signs, fences, or private property, illegal shooting of wildlife, littering, illegal removal of collectible items such as petrified wood, minerals, fossil remains, etc..

The land-oriented user has an inherent interest in the landscape. He wants to get out, away from it all, view the scenery, and experience the remoteness of the area. He will usually stay on existing roads or trails or follow wash bottoms but will, when the need arises, go cross-country. The impacts resulting from this type user would be about the same as the activity-oriented user. However, the land-oriented user is likely to cover more area, "not leave a stone unturned until he has seen the whole country".

Most areas within 3 to 4-hours driving time would be affected by ORV users. Heaviest impacts would occur near towns. Most of the area within 1 to 2-hour drives would be explored and impacted by the land and activity-oriented users. High interest areas within the 2 to 4-hour limits have a high probability of being heavily impacted. The most heavily impacted areas are likely to be the following:

a. Accessible historic and archaeological sites.

b. Outstanding scenic areas such as:

-The southern portion of Glen Canyon National Recreation Area

-The Cockscomb - along Cottonwood Wash

- The Hackberry Canyon Roadless Area
- The Markagunt, Paunsaugunt, and Aquarius plateaus within the Dixie National Forest
- The upper reaches of the Escalante River drainage and the Circle Cliffs area
- The Kaibab Plateau within Kaibab National Forest
- Scenic areas within the Navajo Indian Reservation
- Lower half of Capitol Reef National Monument.

(Note: Zion, Bryce and Grand Canyon national parks should not be significantly impacted by ORVs because of controlled access and close use supervision.)

c. High-value hunting and fishing areas in Dixie and Kaibab national forests.

d. High-value rock-hounding areas such as the petrified wood areas near the Old Paria town site and the area south of Escalante.

Use of ORVs would be dispersed over an area of approximately 30,000 square miles. Controling use over an area this size would be very difficult. Hence, considerable damage to natural and cultural values would likely occur.

The impacts of increased ORV use are further discussed in the following sections: Soils, Vegetation, Wildlife, Paleontology, Archaeology and History, and Land use.

Increased deer hunting pressure from the new residents may have a substantial effect on hunter success. During the 1973 Utah hunting season there were 11,106 hunters afield (Utah Big Game Harvest - 1973) in hunting areas within approximately 100 miles of the proposed new town site. It is estimated that approximately 4,000 new hunters afield would be generated from the new residents which would represent an approximate 35 percent increase in hunting pressure (it is assumed that the majority of the use will occur in Utah). Deer herds in the area are at a 20 to 30-year low in population. The increased hunting pressure would likely cause a proportionate decrease in hunter success (see Wildlife section for details).

Heavy traffic along the new highway and Highway 12 would create congestion and introduce a noise and disturbance factor that would adversely affect the quality of experience for recreationists. This would be particularly severe in Bryce Canyon National Park where the noise from the heavy truck traffic on Highway 12 would be audible to the users in part of the park. As stated, Bryce Canyon had 431,000 visitor days in 1973. Factors contributing to the traffic problem are as follows:

- There are presently 40 trips per day by oil tankers along Highway 12 from the Upper Valley oil field.
- During the 10-year construction phase there would be approximately 6,000 hauls by commercial-weight trucks. Many of these hauls (20 hauls at 125 tons and 200 hauls at 50 tons) would be slow-moving wide loads.
- For the life of the project, there would be 60 one-way trips per day by truck-trailer outfits from the limestone quarry to the plant. The route would include Highway 12 through the northeast corner of Bryce Canyon National Park.
- During the approximate 3-year peak demand period, there would be 18 truck-trailer trips per day delivering fuel oil to the plant, and three to four trips per day during the average demand period. These would be on Highway 89 and the new highway.
- There would be approximately 1,600 commuter trips per day for the employees working at the plant and mines. Most of the trips would likely be on the new highway south of the plant but some would originate to the north.

Noise in the construction area should not significantly affect the recreation user. During the construction phase noise created by portable diesel generators at the plant sites and heavy equipment would have some effect on the few recreation users that would be expected in the impact area. Heavy equipment at the generating station and the coal preparation area would also affect recreationists traveling the new highways during the operation phase of the project.

Transmission system impact area

Cultural values

Physical remains of past cultures, such as buildings, ruins, graves, or various artifacts, could be directly impacted by construction of the proposed transmission system. There would be extremely high potential for damage or destruction of any such cultural resource that may not have been discovered during preliminary archaeological reconnaissance.

Direct effects upon cultural resources in terms of potential loss or reduction of their inherent cultural values would be basically the same as those outlined in the Paleontology, Archaeology and History section of this chapter. The same construction activities (excavation, conductor stringing, tower assembly, road building, etc.) that would affect archaeological and historical resources found in place would affect their cultural values. Physical damage would be very likely because resources encountered would not be easily detected on or near the surface, but would be uncovered during excavation, roadcutting, and blading operations. It would be almost impossible to operate bulldozers, backhoes, graders and other heavy equipment to avoid damaging or destroying cultural resources in the immediate work area.

Inherent sightseeing and recreational values of such historic features as Camp Young in southern California, the Old Government Road near the California-Nevada border, and the Escalante, Old Spanish, Temple, and Old Mormon trails would be adversely impacted during construction. Since there are no figures available on numbers of recreationists who utilize or visit the trail routes, or the exact nature of their activities in these areas, it is impossible to quantify potential impacts of the transmission system construction upon these recreational opportunities.

It can be assumed that construction areas would be closed to public use, reducing or eliminating sightseeing opportunities, while crews and equipment are present. Dust, noise, fumes, and waste materials present during construction phases would also tend to degrade the quality of any recreational experiences associated with cultural resources.

The total time that public recreation would be affected depends upon the season when actual construction takes place in a given area, and length of time crews and equipment remain.

The Bureau of Land Management is planning to mark the Dominguez-Escalante historic trail as an interpretive site on U.S. Alternate Route 89, southeast of Fredonia, Arizona, in conjunction with the 1976 American Bicentennial celebration. The trail would be crossed by the proposed Kaiparowits to Eldorado line segment at the base of Hurricane Cliffs. Impacts of the proposed transmission line would be negligible because there is an existing 500 kilovolt (kV) transmission line within 2,000 feet of the same crossing. No physical evidence of the Escalante Trail exists on the ground surface in this area.

Camp Young would be impacted by construction activities in its extreme northwest corner, and near Chiriaco Summit. Construction and operation phases would detract from historical sightseeing opportunities at Camp Young by creating dust, noise, traffic, fumes, surface disturbances, and human occupation in the immediate area.

Major impacts upon cultural values would be expected as a result of public use of access roads. Illegal artifact collecting would likely occur wherever there is vehicle access to archaeological areas. Looters could destroy scientific, educational, and recreational values of cultural resources by removing them from their original context.

Cultural sightseeing features can lose much of their basic appeal and therefore recreational value, if a site is in or near a transmission line right-of-way. Presence of a 500 kV transmission line and associated surface disturbances

would detract from the recreational experience in areas such as Camp Young and at historic trail crossings.

Natural values

Proposed transmission system facilities would adversely impact recreational value of highly scenic geological features throughout the route areas. Glen Canyon, Echo Cliffs, and the Gap on the Kaiparowits to Moenkopi switching station segment have significant geological sightseeing value, but are presently impacted by existing transmission lines and access roads. A new 500 kV transmission line would tend to further degrade any sightseeing experiences in this area.

Greatest impacts upon most scenic geologic features along the Kaiparowits to Eldorado segment would be visual intrusions from roadcutting and disturbance around tower assembly areas. Although there is an existing 500 kV transmission line through the Cockscomb, Beaver Dam Mountains, and Lava Butte-Rainbow Gardens, the proposed new line would further intrude upon geological sightseeing values in these areas.

The proposed Moenkopi to Mohave 500 kV transmission line would cross steep, scenic faces of the Coconino Rim, Aubrey Cliffs and Cottonwood Cliffs parallel to an existing line. Towers would be placed at the top and bottom of each cliff area, with only conductor lines descending exposed rock strata. Towers, conductors and access roads would cause only moderate additional impacts upon geological sightseeing values in these areas. The proposed Arizona Strip preferred alternate would cross the Bureau of Land Management Virgin River Recreation Lands in Nevada. This area was established primarily for wildlife and vegetation protection, therefore, the majority of impacts would affect these resources. (Refer to impacts in the Wildlife and Vegetation sections of this chapter).

At present there are no high voltage transmission lines in Silverado Canyon. Placement of the proposed route would create major visual intrusions.

Increased public access via the estimated 1,900 miles of new roads would provide additional opportunity for vehicular travel to previously inaccessible areas. An influx of vehicles using these roads could cause increased soil erosion on the roads, wildlife disturbance, off-road vehicle damage to fragile soils, vegetative loss, and introduce an undetermined number of additional recreationists to transmission system areas (see Figure III-56).

Adverse impacts upon vegetation, wildlife, soils, water and air quality, or other natural resources, may in turn reduce the quality of outdoor recreation activities and public enjoyment of natural environments. The major impact would be visual or aesthetic wherever vegetation is removed, since most recreation activities along the proposed transmission system would not be dependent on small areas cleared for the transmission lines, access roads, and communications sites.

Water-based recreation at the proposed Colorado River crossing point directly south of Bullhead City, Arizona would be temporarily disrupted while transmission line construction is in progress. Fishing, boating, sightseeing, and shoreline access would be displaced along the river while crews and equipment are operating in the immediate area. For some visitors, traffic, noise, dust, and exhaust fumes at construction sites would detract from the quality of recreation activities ordinarily available at the proposed crossing point.

FIGURE III-56

New Roads Increasing Public Access
and Recreational Opportunities

Proposal	New Roads (mi) Permanent	Temporary	Total
Primary proposal	870	1,030	1,900
Northern Kaiparowits proposal	735	1,030	1,765
Arizona Strip proposal	1,055	1,030	2,085

Vehicle traffic on the river bank could increase if access roads and tower assembly areas remain cleared. Any increase in recreational use along the right-of-way would cause increased soil erosion and sedimentation along the river bank, especially if new vehicle access is created. For some visitors, sedimentation and vehicular activity could reduce the quality of recreational opportunities.

Air quality in or near construction areas would be degraded for brief periods by blowing dust, exhaust fumes, and smoke if slash burning is allowed. Any increase in air pollution over a given area would reduce sightseeing opportunities and generally detract from scenic values and enjoyment of natural surroundings.

After construction is complete, dust could continue to be a problem along access roads from recreational vehicles. Construction of the transmission line system, including new roads, tower sites, batch plant sites, assembly, and pulling sites would remove some lands from the recreation base. Number of acres permanently and temporarily removed from the recreation baselands are given in Figure III-57.

Primitive-wilderness values

There are no designated primitive or wilderness areas that would be directly impacted by construction, operation, or maintenance of the proposed Kaiparowits transmission system and communication system facilities.

The proposed Kaiparowits to Eldorado segment would pass about 1 mile from the Buckskin entrance to Paria Canyon Primitive Area; however, no direct impacts to the canyon itself should occur as a result of line construction activities. The proposed routes would pass near existing and potential primitive areas. In most cases, however, the proposed transmission system would not physically impact natural and primitive values themselves, but rather would tend to degrade recreational experience for some visitors by lowering aesthetic appeal.

FIGURE III-57

Recreation Base Lands Occupied by Proposed Transmission Lines (Estimate)

Primary Proposal	[a]Land occupied by free standing towers	[b]Land occupied by guyed towers
Kaiparowits - Phoenix	34.89	0
Kaiparowits - Navajo	5.51	0
Kaiparowits - Eldorado	3.73	826.45
Kaiparowits - Moenkopi - Mohave	4.59	964.19
Devers - Mohave 1 and 2	5.51	1,193.73
Devers - Serrano 1 and 2	21.12	0
	75.35	2,984.37

Acres of substation = 135
Acres of microwave site = 5
Total acres of recreation base lands occupied = 3,199.72

Northern Kaiparowits Proposal

Kaiparowits - Phoenix	34.89	0
Kaiparowits - Navajo	5.51	0
Kaiparowits - Eldorado	3.73	826.45
Northern Kaiparowits - Mohave	3.73	1,051.42
Devers - Mohave 1 and 2	5.51	1,193.76
Devers - Serrano 1 and 2	21.12	0
	74.49	3,071.63

Acres of substation = 135
Acres of microwave sites = 5
Total acres of recreation base lands occupied = 3,286.12

Arizona Strip Proposal

Kaiparowits - Phoenix	34.89	0
Kaiparowits - Navajo	5.51	0
Kaiparowits - Eldorado	3.73	826.45
Arizona Strip	3.73	987.14
Devers - Mohave 1 and 2	5.51	1,193.76
Devers - Serrano 1 and 2	21.12	0
	74.49	3,007.35

Acres of substation = 135
Acres of microwave sites = 5
Total acres of recreation base lands occupied = 3,221.84

[a]Towers and foundations occupy 40 x 40 feet area)
[b]Includes all lands within guyed zone (200 x 200 feet)

Aesthetics

Since aesthetics deal with perception of environments, any added physical element such as the proposed Kaiparowits transmission system would affect different viewers in different ways. There is no way to blend proposed towers, conductors, or microwave repeaters into the natural landscape to avoid all visual intrusions. Even where scenic values are relatively low, transmission lines would obviously stand out as unnatural intrusions on the landscape.

Construction impacts upon aesthetics would vary from severe to relatively low, depending upon numbers of viewers exposed to the proposed operations in various settings. Construction crews, equipment and materials would detract from aesthetic values whenever they can be seen by the general public during construction. This normally would occur at all road and highway crossings, and wherever actual construction activities are within view of highways. Construction equipment, traffic and associated exhaust, dust, noise, and congestion in public road and highway areas would effectively negate any opportunity to enjoy the scenery in the immediate area.

Much of the proposed transmission line system would be visible from existing back roads. Litter and construction waste would be offensive to back-country recreationists since temporary service facilities such as construction camps, material storage yards and batch plants could be viewed during the construction periods.

Aesthetic impacts of proposed transmission system facilities would vary along different route segments after construction is completed according to present visual intrusions. Aesthetic values along some segments have been significantly degraded by existing access roads, towers and conductors. The presence of a second transmission line would not affect a viewer's perception of natural beauty as seriously as the location of a first line through an undisturbed viewshed; however, visual impacts would be somewhat increased.

Noise, dust, fumes, refuse, traffic and human activity during construction phases would cause substantial impacts upon other aesthetic elements. These would be especially noticeable in high-human-influence zones such as urbanized areas and highway crossings.

Arizona Public Service, participant for the proposed Kaiparowits to Westwing transmission line, has suggested free-standing-type towers with a 2,000-foot lateral separation from existing parallel lines. Land Uses, Chapter II, describes the 2,000-foot separation proposal.

Southern California Edison has also proposed a 2,000-foot separation along lines of the primary proposal, the Northern Kaiparowits proposal and the Arizona Strip proposal. From an aesthetic standpoint, the 2,000-foot separation concept would create greater impacts than placement of a new transmission line on an adjacent right-of-way. There would be fewer opportunities to minimize new impacts by using areas already disturbed or developed for the existing lines. For instance, there would be fewer available access roads and a new skyline intrusion would be introduced in what is essentially a separate, undisturbed corridor.

To determine significant impacts the proposed transmission and communications system would exert on the landscape, the following two aspects of visual patterns have been analyzed. These two aspects define the visual setting and, when combined, form the basis of the environmental impact judgement.

Visual exposure: Defined as varying degrees (high, moderate, and low) of the transmission line's exposure to view sources (e.g. highways, communities, etc.). Criteria for a relative high, moderate, or low exposure rating is proximity to view sources. The closer the proposed route is to a view source such as highway, populated areas, or recreation areas, the higher the exposure rating would be.

Visual absorption: Defined as varying degrees (high, moderate, and low) of visual integration between the transmission line and surrounding landscape

character. This is a measure of the capacity of the terrain to, in effect, "conceal" the transmission line within its visual characteristics. Criteria for a relative high, moderate or low absorption rating are:

Topographic landform complexity, such as changes in terrain slope in relation to the transmission line.

Topographic relationship to the transmission line, such as the corridor being sited parallel or perpendicular to contours of the land.

Natural surface textures, such as rock and vegetative patterns.

Existing parallel transmission lines and general urban development.

High and medium impacts would occur in the scenic areas, highway crossings, human influence areas, and viewsheds over the four proposed transmission line segments shown in Figure III-58 and -59. Percents of miles of line which are visible for the segments are given in Figure III-60. Also total numbers of miles of line visible and percentages are given for the proposed transmission line routes.

Visitor use figures are given for major highway crossings where the transmission lines would be readily visible (see Figure III-58). Degree of impact of the transmission lines would depend on number of viewers and on viewer reactions to intrusions caused by transmission line system construction and maintenance.

Areas that would suffer relatively low impacts were not listed, but generally coincide with low-rated scenic values as depicted in Illustration II-59, Chapter II.

The accompanying photographs depict artists' conceptions of the appearance of transmission line towers and conductors on various line segments. "Before" photographs have no visible line; "after" illustrations contain one new line, portraying visual impacts created wherever a 2,000-foot separation is proposed. Such a separation would effectively create a new corridor nearly 1/2 mile from existing lines.

FIGURE III-58

Estimated Vehicular Traffic Along Highway Crossings and Areas Where Transmission Lines Are Visible From Major Highways - 1973

Line Segments		Number of Vehicles Daily Average
Kaiparowits - Phoenix		
Utah Highway	89	835
Arizona "	89	8,988
" "	180	3,722
" "	40	9,760
" "	89	2,771
Cordes Junction		6,689
I-17		127,229
		159,994
Kaiparowits - Navajo		
Utah Highway	89	835
Arizona "	89	8,988
		9,823
Kaiparowits - Eldorado		
Utah Highway	89	835
Arizona "	89	732
" "	389	373
" "	15	5,070
Nevada "	91	5,550
" "	95	11,850
" "	68	430
" "	95	1,875
" "	77	800
		34,525
Kaiparowits - Moenkopi - Mohave		
Utah Highway	89	835
Arizona "	89	8,988
" "	180	3,722
" "	40	13,527
" "	93	4,343
" "	60	5,323
" "	64	5,061
" "	95	1,820
		43,614
Northern Kaiparowits		
Utah Highway	89	835
Arizona "	89A	732
" "	389	373
" "	15	5,070
Nevada "	91	5,550
" "	95	11,850
" "	68	430
" "	95	1,875
" "	77	800
		27,515
Arizona Strip		
Utah Highway	89	835
Arizona "	89A	732
Nevada "	12	880
" "	91	5,550
" "	93	5,957
" "	95	11,850
" "	68	430
" "	95	1,875
" "	77	800
		28,909
Mohave - Serrano		
California Highway	U.S. 95	2,300
" "	I 40	6,600
" "	U.S. 62	640
I-10/Joshua Tree Monument Parallel		19,500
	S 177	2,200
	S 243	1,500
	S 79	3,300
	S 71	8,600
	U.S. 395	17,300
		61,940

FIGURE III-59

Aesthetic Impacts of Kaiparowits Transmission System Line Segments on Scenic Values

Preferred Route Segment	Name of Impacted Area	Approximate Linear Miles of Line Affected	Degree of Impacts	Scenic Values	Visually Vulnerable
Kaiparowits to Westwing					
	Glen Canyon National Recreation Area	10.5	High	X	X
"	Colorado River Gorge	.5	High	X	X
"	Little Colorado River Crossing	.5	High	X	X
"	Hells Point	4.5	Medium	X	X
"	Verde River Crossing	2.0	High	X	X
"	Yeager Canyon Recreation Area	2.0	High	X	X
"	Lake Pleasant (Maricopa Co. Park)	2.0	High	X	X
"	U.S. 89 Navajo Indian Res.	15.5	Medium		X
"	U.S. 180	2.0	Medium		X
"	State 64	3.0	Medium		X
"	U.S. 89 Ashfork-Williams	2.0	Medium	X	X
"	U.S.89 Ashfork-Prescott	15.0	Medium	X	X
"	U.S. 89A	2.0	Medium		X
"	Cordes Junction 69 & 17	10.0	High	X	X
"	Interstate 40	1.0	Medium		X
"	State 169	2.0	Medium		X
"	Black Canyon Highway	5.0	High	X	X
"	Verde River	1.0	Medium	X	X
		80.5 miles			
Kaiparowits to Navajo					
"	U.S. 89	6.0	Medium		X
"	U.S. 89A	1.0	Medium		X
"	Colorado River	1.0	High	X	X
		8.0 miles			
Kaiparowits to Eldorado					
	The Cockscomb	25.0	Very High	X	X
"	U.S. 89	1.0	Medium		X
"	Hurricane Cliffs	2.0	Medium	X	X
"	Black Rock Canyon	4.0	High	X	X
"	Beaver Dam Mountains	10.0	Medium/ High	X	
"	Beaver Dam Wash	4.0	Medium/ High		X
"	Glendale, Nevada	5.0	Medium		X
"	U.S. I-15 Crossing	2.0	Medium		X
"	Lava Butte Rainbow Gardens	6.0	High	X	X
"	U.S. 95 Crossing	4.0	High		X
"	Las Vegas Dunes Recreation Area	2.0	Medium		X
		65.0 miles			
Moenkopi to Mohave					
	Coconino Rim	1.0	Medium	X	
"	U.S. 180 Crossing	5.0	High	X	X
"	Aubrey Cliffs	2.0	Medium	X	
"	U.S. 66 I-40	6.0	Medium/ High	X	X
"	Cottonwood Cliffs	8.0	High	X	
"	Hualapai Valley	15.0	High		X
"	McConnico Area	4.0	High		X
"	Black Mountains	8.0	High	X	X
"	Colorado River Crossing	2.0	High	X	X
		51.0 miles			

(continued)

FIGURE III-59 (continued)

Aesthetic Impacts of Kaiparowits Transmission System Line Segments on Scenic Values

Preferred Route Segment	Name of Impacted Area	Approximate Linear Miles of Line Affected	Degree of Impacts	Scenic Values	Visually Vulnerable
Mohave to Serrano					
	First 5 miles	5.0	High	X	X
"	U.S. 95 Crossing	4.0	High		X
"	I-40 Crossing	2.0	High		X
"	Granite Pass	2.0	High	X	X
"	Coxcomb Mountains	8.0	High	X	
"	U.S. I-10/Joshua Tree Ntl.Monument Parallel	65.0	High	X	X
"	North Palm Springs	15.0	High	X	X
"	San Jacinto Mountains	25.0	High	X	X
"	Serrano Substation	36.0	Medium		X
		162.0 miles			
Northern Kaiparowits to Mohave Preferred Alternate					
"	The Cockscomb	25.0	Very High	X	X
"	U.S. 89	1.0	Medium		X
"	Hurricane Cliffs	2.0	Medium	X	
"	Black Rock Canyon	4.0	High	X	X
"	Beaver Dam Mountains	10.0	Medium/ High	X	
"	Beaver Dam Wash	4.0	Medium/ High		X
"	Glendale, Nevada	5.0	Medium		X
"	U.S. I-15 Crossing	2.0	Medium		X
"	Lava Butte Rainbow Gardens	6.0	High	X	X
"	U.S. 95 Crossing	4.0	High		X
"	Highland Mountains	6.0	Medium	X	X
"	Highway 95	12.0	Medium		X
"	Highway 77	7.0	Medium		X
		88.0 miles			
Arizona Strip Preferred Alternate					
"	U.S. 89	2.0	Medium		X
"	U.S. Alt 89 South of Fredonia	2.0	Medium		X
"	Virgin Mountains	18.0	High	X	X
"	U.S. 12	2.0	Medium	X	X
"	U.S. 91	4.0	Medium		X
"	Virgin River Recreation Lands	1.0	High	X	X
"	U.S. 93	2.0	Medium		X
"	Las Vegas Dunes Recreation Lands	2.0	Medium		X
"	U.S. 95 Crossing	4.0	Medium	X	X
"	Highland Mountains	6.0	Medium	X	X
"	Highway 95	12.0	Medium		X
"	Highway 77	7.0	Medium		X
		62.0 miles			

FIGURE III-60

Visual Impacts of Kaiparowits Transmission System Line Segments

Line Segments	Total Miles	Percent of Line Visible
Kaiparowits to Phoenix	299	27
Kaiparowits to Navajo	47	17
Kaiparowits to Eldorado	269	24
Moenkopi to Mohave	195	26
Mohave to Serrano	267	60
Northern Kaiparowits to Mohave Preferred Alternate	327	27
Arizona Strip Preferred Alternate	309	20

Proposed Routes	Total Miles of Line	Total Miles Visible	Percent Visible
Primary Proposal Kaiparowits - Phoenix, Kaiparowits - Navajo, Kaiparowits - Eldorado, Kaiparowits - Moenkopi - Mohave, Mohave - Serrano	1,457	366.5	25%
Northern Kaiparowits Proposal Kaiparowits - Phoenix, Kaiparowits - Navajo, Northern Kaiparowits Mohave Preferred Alternate, Mohave - Serrano	1,476	338.5	23%
Arizona Strip Proposal Kaiparowits - Phoenix, Kaiparowits - Navajo, Arizona Strip Preferred Alternate, Mohave - Serrano	1,440	312.5	22%

Illustration III-5 shows typical scenery in the southern portion of the Kaiparowits to Phoenix segment, while Illustration III-6 shows the addition of a 500 kV line to this scene. The proposed line would have a 2,000-foot separation from existing lines. Illustration III-7 shows the proposed Highway 89 crossing near Glen Canyon. Illustration III-8 shows the artist's conceptions of a single 500 kV line on guyed delta towers, added to the scene in Illustration III-7. Illustration III-9 shows an existing Bureau of Reclamation 230 kV transmission line at the I-40 crossing east of Kingman, Arizona. The existing transmission line is highly visible to passing motorists and intrudes upon the southern view toward the Hualapai Mountains. Addition of the proposed Southern California Edison 500 kV transmission line along a parallel right-of-way is shown in Illustration III-10. Illustration III-11 shows the scene at Highway 66 near Camino substation. While Illustration III-12 depicts proposed twin 500 kV lines on guyed delta towers, they would appear in the same corridor with existing transmission lines along the Mohave to Serrano segment.

There would be 40 proposed microwave sites, of which eight would be new, 16 would be expansions of existing sites and 16 would be existing with no expansion. These sites would create some visual intrusions on those mountain peaks and other high points affected. O'Leary Peak, Hutch Mountain and Towers Mountain sites would be on peaks within the Coconino or Prescott national forest lands in Arizona.

The proposed Southern California Edison repeaters with highest visual vulnerability or potential for aesthetic impacts are:

Buckskin - off U.S. 89 between Kaiparowits plant site and Kanab, Utah.

Beaver Dam - west of I-15 in extreme southwest Utah.

Glendale - north of I-15 in northwestern Clark County, Nevada.

Intake - located within Glen Canyon National Recreation Area, northeast of U.S. Highway 89.

Spirit Mountain - east of U.S. 95 in extreme southern Nevada.

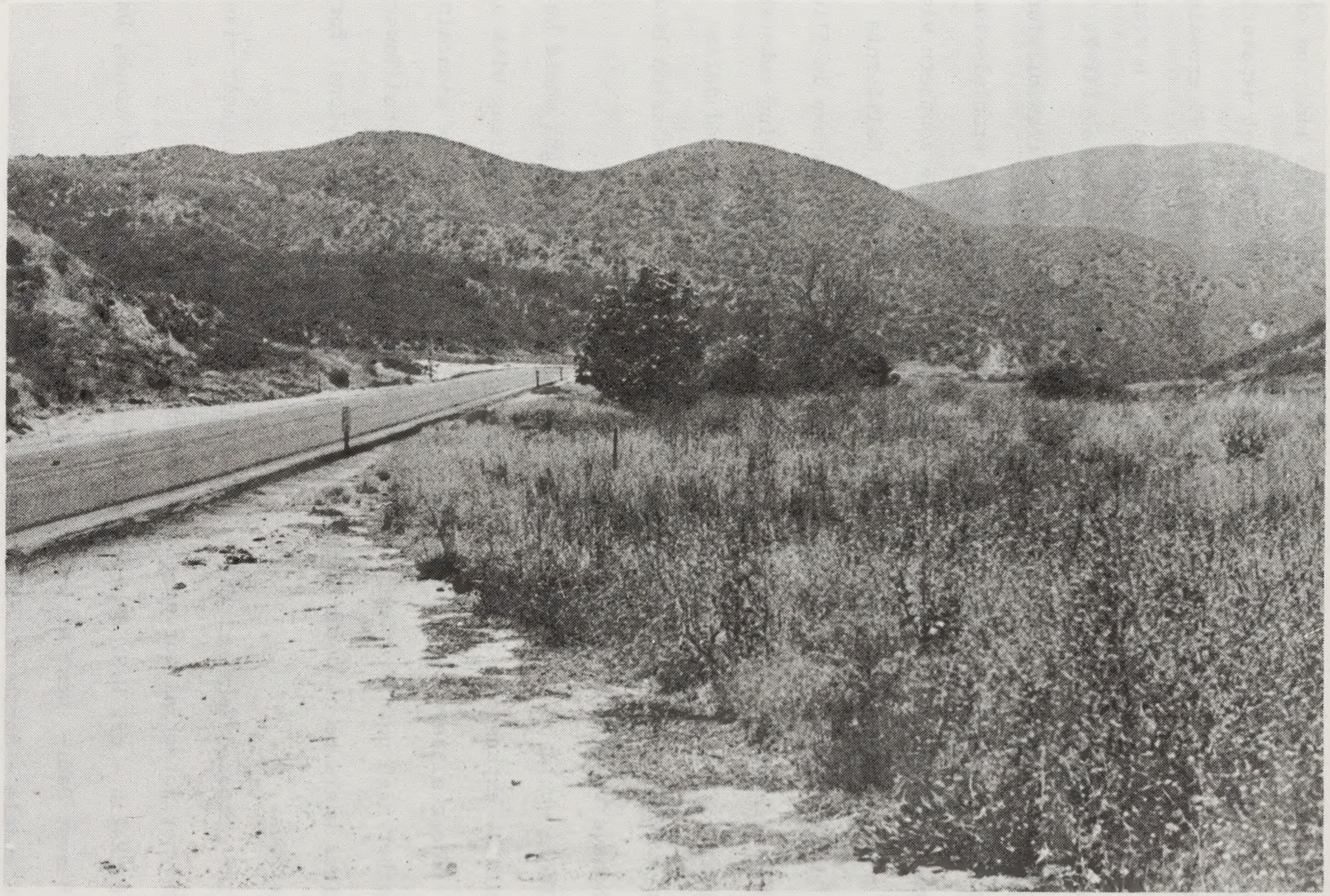


ILLUSTRATION III-5

Scenery on Southern Portion of Proposed Arizona Public Service
(Kaiparowits to Phoenix Route)

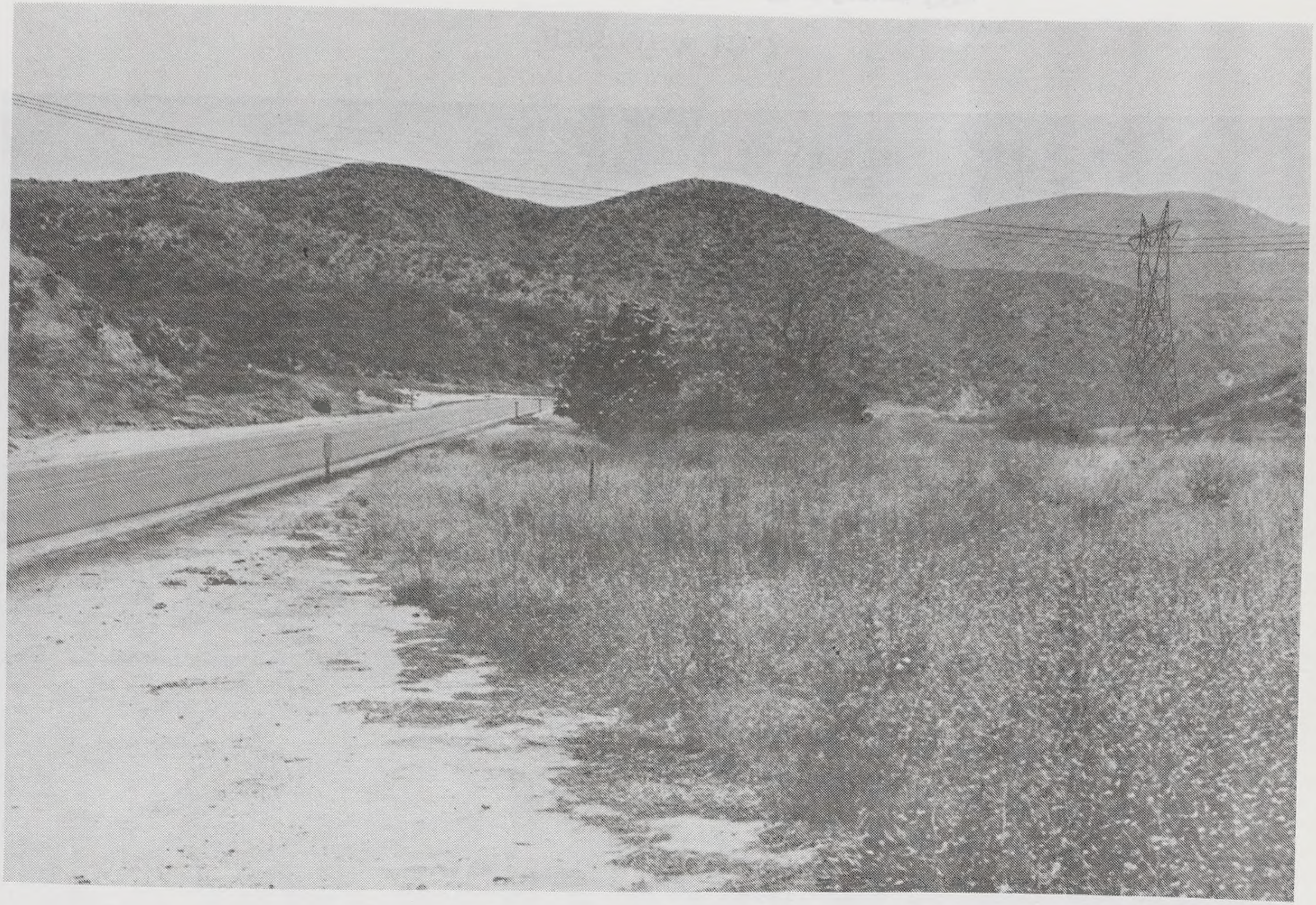


ILLUSTRATION III-6

Illustration III-5 with Single 500 kV Line of Free Standing Tower Added
(2,000 Foot Separation from Existing Lines)

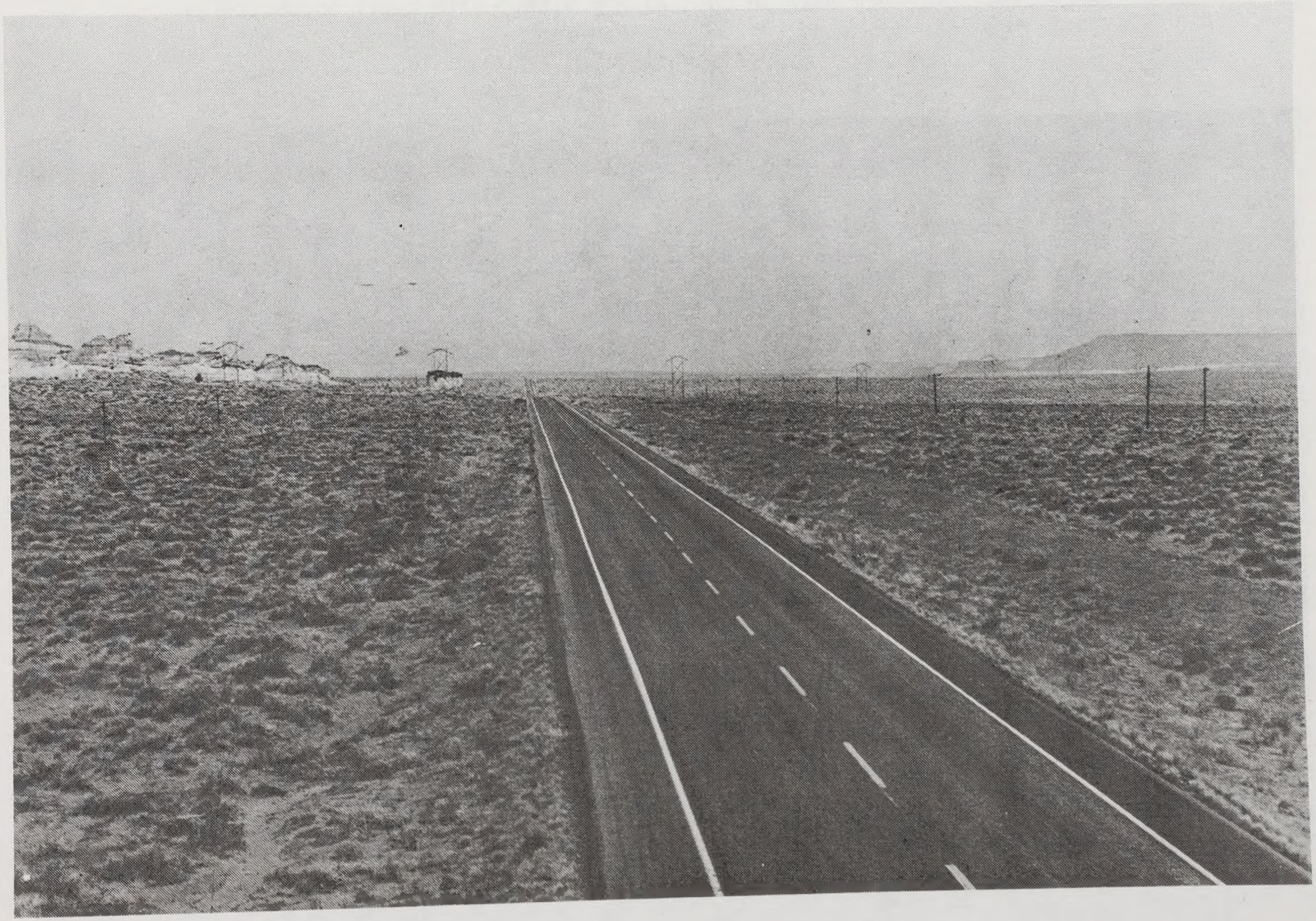


ILLUSTRATION III-7

Western View of Highway 89 Near Glen Canyon City

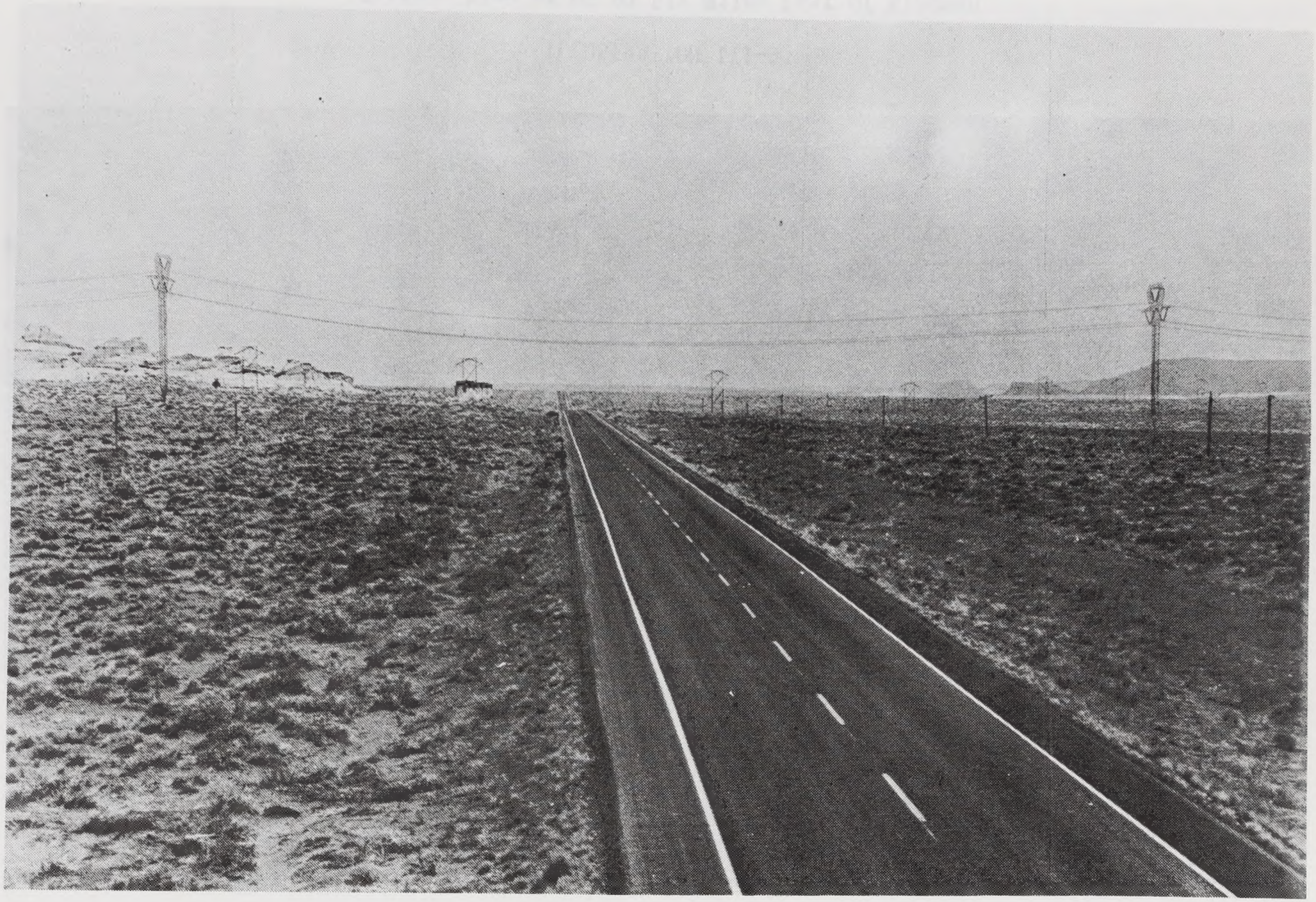


ILLUSTRATION III-8

Illustration III-7 with Single 500 kV Line on Guyed Delta Towers Added

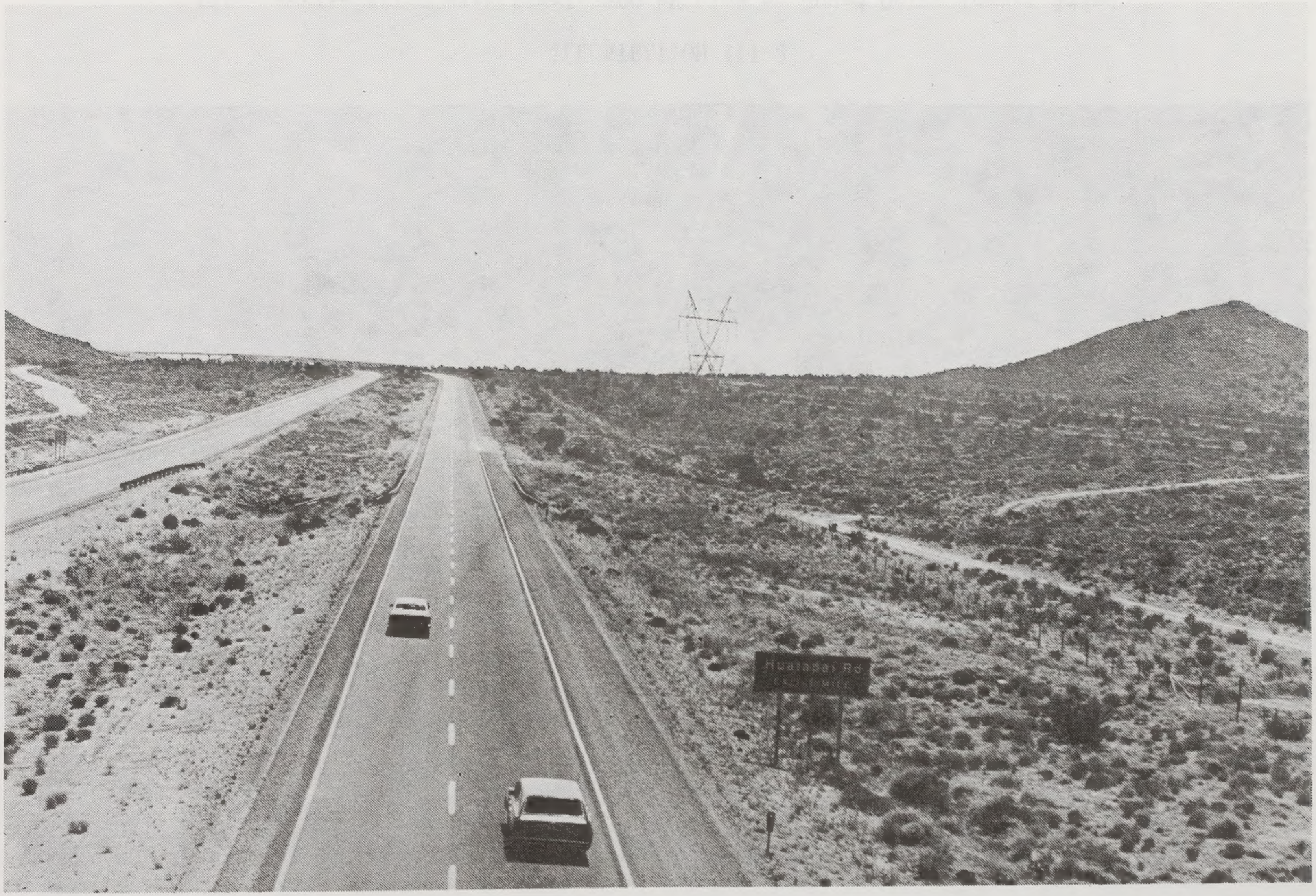


ILLUSTRATION III-9

Eastern View of US 93 Six Miles East of Kingman
(Moenkopi to Mohave Segment)

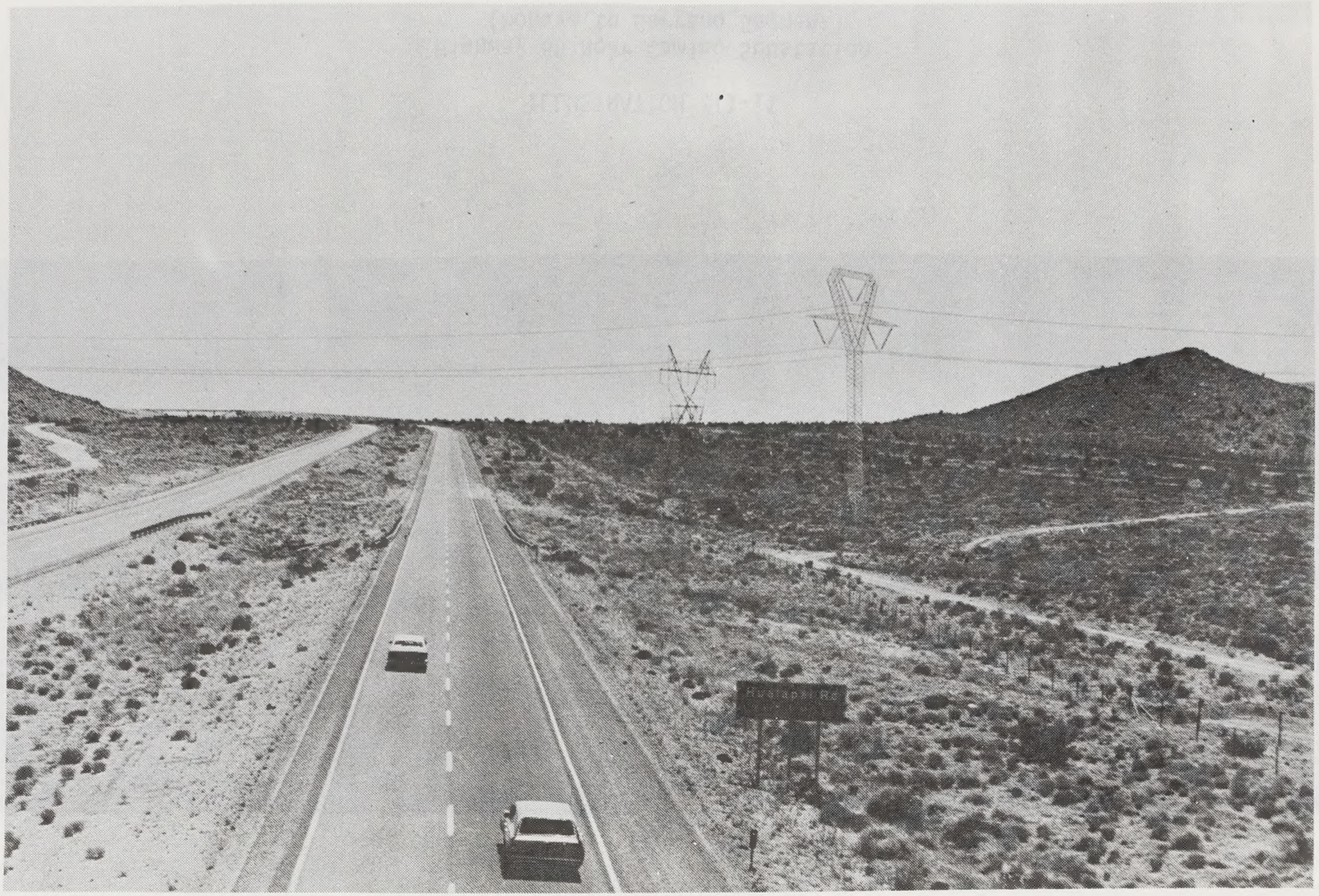


ILLUSTRATION III-10

Illustration III-9 with 500 kV Line on Guyed Delta Towers Added

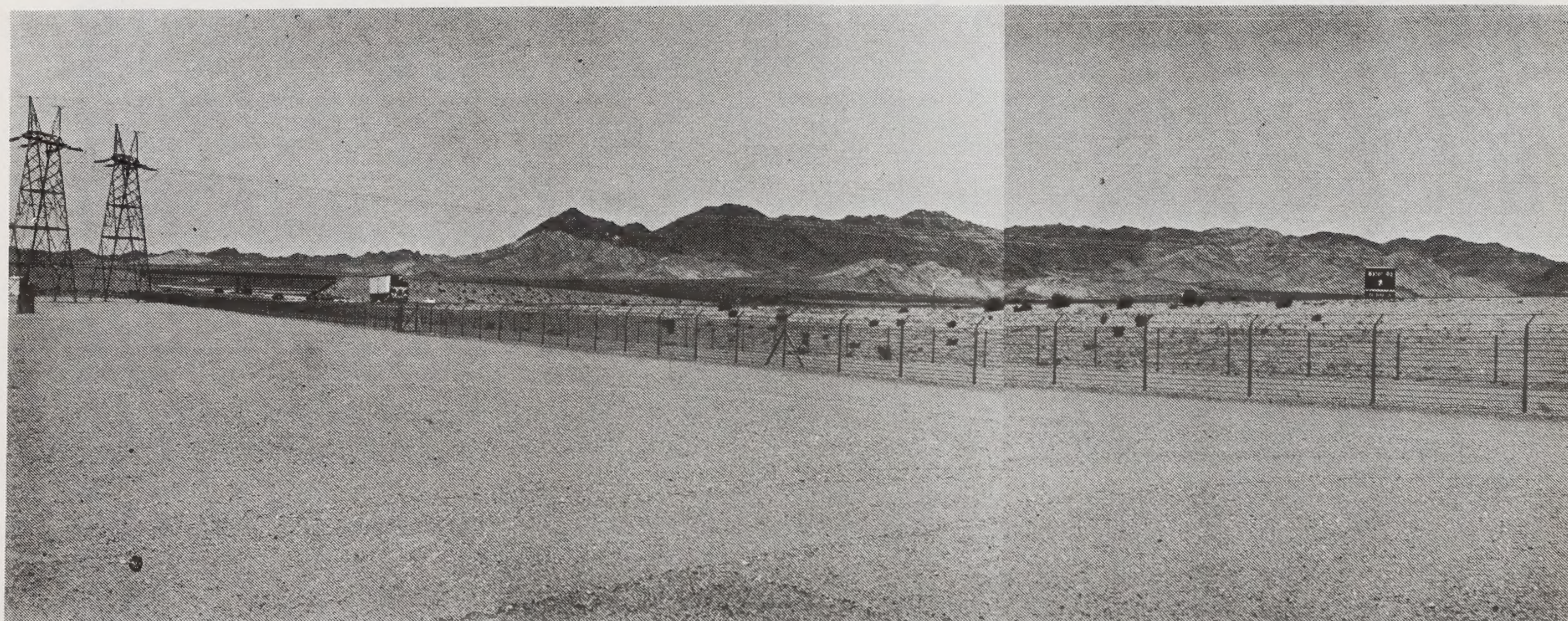


ILLUSTRATION III-11

Highway 66 Near Camino Substation
(Mohave to Serrano Segment)

ILLUSTRATION III-12

Illustration III-11 with 500 kV Line on Guyed Delta Towers Added

Flat Top - west of the I-40, U.S.93 junction in eastern San Bernardino County, California.

Santiago Peak - inside the northeast boundary of the Cleveland National Forest in western Riverside County, California.

The other repeater sites would not be readily visible from major travel routes, however, they would create visual intrusions for back-country users.

Development

The proposed Mohave to Serrano route would pass south of Indio Hills County Park.

Impacts on the proposed Edam Hill Recreation Vehicle Park would be limited mostly to aesthetics. Physical existence of the line and towers should have no impact on recreation vehicle recreationists if and when the park is developed.

Aesthetic impact on the Glen Ivy Recreation Vehicle Park would be more obvious. The park is located in a scenic area at the foot of the Santa Ana Mountains. The proposed route would pass southwest of the park traversing open space between the park and Santa Ana Range. The visual impact could be offensive to park users and sightseers. There would also be similar visual impacts to Irvine and Villa Park Dam county parks. The proposed route crosses to the north of the Las Vegas Dunes Recreation Area. Impacts to this area would be primarily aesthetic, and would be considered minimal because of the existing heavy use and degradation of the area.

The proposed route would traverse the northern section of Canyon Lake. The lake section actually crossed by the line is shallow and not used by water sports enthusiasts. The main body of the lake is heavily used for boating and waterskiing. Portions of the transmission line would not be visible from the residential area on the east side of the lake but would have a definite negative impact on recreationists using the lake.

No additional recreation developments would be directly impacted by the proposed transmission line routes, though there would be some indirect aesthetic impacts in other areas. Natural areas both existing and potential, that would be impacted from an aesthetic standpoint include the Virgin Mountains, Rainbow Gardens, Kanab Creek, Las Vegas Wash, Joshua Tree Natural Area, Sacramento and Highland mountains.

The appreciation of natural values and significant outdoor recreation areas, such as Glen Canyon National Recreation Area or Joshua Tree National Monument, would suffer to some degree. Although a small transmission line currently crosses the Joshua tree entrance road near the monument portal, the addition of two high voltage lines could result in a serious visual impact. The resource itself would not actually be impacted, but visitors could possibly be offended by the presence of proposed transmission and communications facilities. This would be more applicable to natural environment areas, or areas with primitive qualities than near already developed recreation sites. (Refer to Illustration II-54, Chapter II, for affected adjacent resources.)

There are also several alternate uses for the areas under the proposed transmission lines. Such uses could include horseback riding trails, parks, playgrounds, golf courses, hiking trails, and off-road vehicle use. These alternate uses would most likely occur in urban areas; for example, along the proposed route from Valley to Serrano. These alternate uses could be beneficial impacts, however, they could have corresponding adverse impacts such as increased fire danger and vandalism.

The primary impact to recreation use would be disruption of natural landscape by transmission lines and communication sites. Where existing transmission systems occur along proposed routes, the natural landscape would still be altered but less severely than where no lines currently exist. Construction would reduce visual quality of areas viewed by the public. The degree of impact

would vary, dependent on distance, landscape being crossed, location of line on the landscape, and viewers attitude toward the presence of transmission lines and communication sites.

Recreational development potential would be affected in the proposed county park south of Bullhead City, Arizona. Natural, education-scientific, interpretive, and/or scenic values could be reduced to a point that a particular area would no longer have the same potential for satisfying public recreational demand.

Recreational activities such as off-road vehicle use and rock hounding would benefit from increased access along proposed routes. Hunter success would also be improved the first few years, but thereafter would decline because of reduced animal populations. Additional sightseers would be attracted by the improved road system. Miles of new permanent road by proposal would be as follows:

Primary proposal - 870 miles

Northern Kaiparowits proposal - 735

Arizona Strip proposal - 1,055 miles

New roads would not be located entirely in geographic areas containing no roads; many would be parallel to but separated 2,000 feet from existing transmission system roads. Since recreational land use impacts are predominantly based on individual attitudes toward various forms of intrusion, impacts have not been quantified.

Limestone quarry impact area

The impacts on recreational resources as a result of the development and operation of the quarry would be minimal. The vegetative resources on 240 acres and related recreation activities would be lost for the duration of the project. The quarry operation and associated facilities would alter the character of the landscape and have an adverse effect on the aesthetic values. These impacts would be essentially concealed from view of travelers along the Johns Valley County Road.

Quarry related activities visible from Johns Valley Road may create visual distractions, including:

- the haul road into the quarry site.
- administration facilities at the quarry site.
- dust from the blasting and mining operations.

These activities would be visible only from a short stretch of the road and would have a minimal impact. The indirect effects could be substantial. Most severe would be the impact of truck hauling on tourist traffic along Johns Valley Road; Highway 12 through Bryce Canyon National Park, Tropic and Cannonville; and the new highway to the generating station. Refer to previously discussed assessment of this impact.

The quarry property would likely be closed to hunting while the mine is in operation which would result in an annual loss of approximately 10 to 20 hunter days. The quarry operation would attract some visitors. Travel along the haul road and visitation at the mine could be hazardous to visitors.

LAND USE

Kaiparowits Plateau impact area

Introduction

Implementation of the proposal would temporarily affect about 9,460 acres of land and indefinitely affect about 7,320 acres by change from current uses to industrial, transportation, and municipal use. Land ownership and jurisdiction of at least 9,000 acres would be transferred from state and federal to private and municipal control. Most of the present uses of the proposed sites and routes would be excluded.

Some of the proposals would present potential land use conflicts. The proposed East Clark Bench town site is not included in present Kane County zoning which, at the time it was adopted, did not provide for development of a new town. A 230 kV transmission line passes through the proposed town site and the Kaiparowits to Phoenix transmission corridor, as proposed, would also cross the new town. The high voltage transmission lines might affect TV and radio reception and would disturb the aesthetic qualities of the community. Any accidents that would damage the transmission lines could also pose a hazard to the residents of a new town.

Livestock grazing

Development of a generating station, coal mine, and new town would reduce or totally eliminate livestock grazing use in areas affected by these operations. On Fourmile Bench, grazing use would be reduced by 740 animal unit months (AUMs) (148 cattle for 5 months). On the upper Warm Creek Allotment, in the mining area, grazing use would be reduced by 40 AUMs.

Construction of a new town on East Clark Bench would result in reduction of livestock grazing use of up to 450 AUMs (64 cattle for 7 months), depending on design of the town and acreage affected (Bureau of Land Management,

1963-64). Three grazing allotments could be affected, but only one (East Clark Bench, with a possible reduction of 360 AUMs) would be greatly affected. The number of available AUMs on the Clark Bench allotment would be reduced by 19 percent.

Increase in human activity resulting from construction and operation of a generating station and coal mine would affect livestock grazing on adjacent pastures. Livestock poaching, rustling, and harassment may increase as a result of increased off-road vehicle use (see Recreation section). There would also be a reduction in available range and forage adjacent to the town site as a result of increased human activity. However, the amount of forage that would be lost is unknown.

The loss of grazing privileges on Fourmile Bench, the mining area, and East Clark Bench and the disturbance of livestock operations in adjacent areas would have an economic impact on the operators. They could be forced to reduce the size of their herds or even quit the livestock business.

Mineral development

Construction of the plant, mine facilities, roads and town would involve several large sand and gravel mining operations. Approximately 1,600,000 cubic yards of aggregate would be mined. In addition, 800,000 to 1,000,000 cubic yards of clay or mudstone would be excavated for ponds and reservoirs. Both the aggregate and clay operations would be major land uses only during the construction of the projects.

Extraction of coal, aggregate, and clay should not adversely affect future utilization of other mineral resources. Should deep mining for potential uranium deposits take place in the area, the proposed coal workings would have to be avoided. Possible future oil and gas drilling would be restricted in the areas of coal workings, plant site, town site, or other developed areas. However,

oil or natural gas that may be present in the coal mine area would exist in horizons below the coal deposits and would, therefore, not be disturbed by subsidence.

Sand and gravel pits are currently operating near Glen Canyon City. The extent of this sand and gravel deposit is not known, but it can be inferred that some marketable deposits underlie the proposed town site and would be lost to future use by town development. No impacts are foreseen on aggregate sources from location of the proposed plant, coal mining operations, or new highway since no significant aggregate deposits occur in those locations.

Important deposits of clay and bentonitic mudstone found in the Tropic Shale would not be affected since any important occurrences lie away from specific areas involved in the proposal.

As no deposits of titaniferous sandstone, copper, gold, or manganese are known to occur in the areas of the proposed project, no impacts on these minerals would be expected.

The proposal would encourage additional coal development on the Kaiparowits Plateau. Better access into the area would facilitate exploration and development of all types of minerals as well as coal. Development of these minerals would add impacts in proportion to the scale of development.

Wood products

If the proposed power plant is built, there would be an increased demand for firewood and for Christmas trees because of the population increase. The amount of woodland products that might be gathered cannot be accurately estimated, as it would depend on number of fireplaces, weather, and habits and preferences of families. Perhaps as many as 4,000 to 5,000 Christmas trees might be cut annually. Gathering of firewood, which is somewhat recreational, would be excluded on company property on Fourmile Bench. Some needs for firewood could be

met by gathering dead wood in other areas, but continued demands may lead to cutting live trees. A demand for Christmas trees could result in increased cutting in accessible areas and might interfere with the quality and vitality of the woodland. However, in most woodland areas, this reduction of the stand would be beneficial because of expanded brush and grass cover which in turn would reduce erosion and increase forage.

Demands for firewood and Christmas trees would increase utilization of pinyon-juniper woodlands in Kane and Garfield counties. Reduction of woodland could expand brush and grass cover, thereby reducing erosion and increasing forage.

Agriculture

Direct impacts on agriculture, except for livestock grazing, would not occur in the vicinity of the proposed project. However, private owners may sell some agricultural land in Kane and Garfield counties for homesites or other uses. Any resulting reduction in hay production could in turn affect local cattle ranching.

Transportation facilities

Movement of heavy loads during construction could severely damage present roads, and expensive upgrading or repairs would be required. During construction and operation of the plant and mine, traffic would increase due to commuting, truck deliveries and recreational travel.

Proposed haulage of heavy loads, during construction, from Sigurd to Fourmile Bench would include roads where daily traffic in 1973 was from 300 to more than 1,400 vehicles (Utah State Department of Highways, 1973). Net increase in traffic due to haulage would be relatively small but slow movement of very heavy loads would interfere with traffic, damage road systems, and could be a nuisance to residents along the route because of noise and vibration.

During and after construction, the use of existing low-grade roads on surrounding lands would probably increase, and include a wide variety of vehicles. Much of this traffic would be recreational (see Recreation section). Existing roads are not built or maintained for substantial use. Additional concern and expense would be required to prevent deterioration.

A mix of commuter, industrial and recreational use of parts of the proposed highway system could create temporary, localized traffic problems and reduce effectiveness of the system. At least 1,600 commuter trips would be made each weekday with an average of two occupants per vehicle. Congestion and hazards could lead to accidents.

The proposed highway, linking U.S. 89 with State Highway 12, would provide a shorter route between the Lake Powell area and areas to the north, including Bryce Canyon National Park, Escalante, and Capitol Reef National Park. The road distance from Salt Lake City to Lake Powell would be about 23 miles shorter. This linkage would by-pass the present all-weather route through Kanab, and could reduce Kanab's income from tourism. It would however, save travel time and fuel, and might generate a need for traveler services in Bryce Valley.

The potential increase in public carrier traffic could strain present facilities. Conversely, such increases may lead to improved services.

Transmission system impact area

Introduction

Transmission systems and communication sites proposed in Utah, Arizona, Nevada, and southeastern California would occupy predominantly undeveloped, unpopulated western desert-type land. In western California the proposed route would be near several urban areas (see Illustration II-58) and would parallel and cross major highway systems.

Proposed communication sites and transmission lines would not significantly affect current or potential land uses such as livestock grazing, mineral development, wood products, and agricultural production. Recreational land uses such as open space, and residential land use in urbanizing areas would be more significantly affected. Some air traffic transportation systems would be significantly affected. Where transmission lines presently exist, impacts from new lines would be less.

Livestock grazing

Loss of vegetation to access and stub roads, tower construction, establishing temporary maintenance and storage yards, tower assembly sites, and conductor/wire stringing sites would reduce total available livestock forage. Animal unit months of livestock forage lost due to the proposed transmission routes are as follows (see Figures III-42, -43, -44).

Proposed Route	Total Aums Lost (temp. & perm.)	Permanent AUMs Lost
Primary proposal	431	75
Northern Kaiparowits proposal	363	53
Arizona Strip proposal	503	87

Based on miles of proposed line, the following AUMs per mile would be lost:

Proposed Route	Miles of Line	AUMs/Mile
Primary proposal	1,457	0.30
Northern Kaiparowits proposal	1,476	0.25
Arizona Strip proposal	1,440	0.35

Given the small number of animal unit months lost per mile of transmission system, the impact on livestock forage is considered minimal.

A total of 50 AUMs of livestock forage would be lost across the Navajo Indian Reservation (see Figure III-45). This would amount to 0.27 AUMs per mile lost. That forage could support about 21 sheep for 1 year. The magnitude of this impact is unknown as the Navajo Tribe was unable to determine if any family units would be displaced due to this loss.

Existing livestock operations would be disrupted as a result of increased human activity and subsequent crossing of range fences and livestock watering locations. Gates might be left open, and construction camps, storage yards, tower assembly or wire stringing sites could be located near livestock waters and thereby keep the animals away. Fires that endanger livestock and destroy forage could be started by construction workers and equipment. Livestock water might be used for dust control or concrete mixing at batch plants. Potential impacts of these activities would be nonuse of indeterminable amounts of grazing lands during construction activities. No livestock use would be lost to the microwave site.

A beneficial impact on livestock grazing would be better vehicle access for managing livestock and rangelands due to construction of new permanent access roads.

Mineral development

There would be no known impacts on mineral development along the proposed transmission routes.

Wood products

The proposed routes would remove pinyon and juniper trees that could be used for wood products. Removal would make these products unavailable for potential use (Figure III-61).

FIGURE III-61

Vegetation Removed by Acres

Proposed Route	Temp. removal (acres)	Perm. removal (acres)	Total
Primary proposal	1,474	240	1,714
Northern Kaiparowits proposal	1,162	113	1,275
Arizona Strip proposal	1,716	308	2,024

It is unknown how many cords of firewood, numbers of fence posts or numbers of Christmas trees per acre occur along the proposed routes. Consequently, impacts on these products must be considered as relative to acres disturbed by proposal.

Figure III-61 shows recovery rate of pinyon-juniper on temporarily-disturbed acres. Permanently-disturbed acres would be used for tower sites and access roads. New access roads could cause additional impacts on these products by making them more available to the public.

Beneficial impacts from tree removal could occur. Some areas along the proposed routes have shown an increase in livestock and wildlife forage through planned removal, thus allowing better forage species to become established.

Agriculture

The proposed transmission lines would permanently remove 58 acres of agricultural land from production in Riverside County, California (see Illustration II-57).

According to the Riverside County General Plan, (1966) approximately 345,000 acres of land are in agricultural production in the county. The 58 acres amounts to less than two hundredths of one percent. This small acreage however, would add to the rather large invasion of quality agricultural lands by various developments.

Transportation facilities

Although there are numerous impact points along the entire transmission route where the lines cross oil pipe lines, national gas pipe lines, other transmission lines, telephone lines, etc. one major impact area should be mentioned.

The Banning Pass area, a few miles west of Palm Springs, California, contain a network of above and below ground rights-of-ways for oil and gas pipe lines, a a major telephone cable, Colorado Pines Aqueduct, Southern Pacific Railway, Interstate 10, and several major electric transmission lines, and numerous smaller electric and telephone distribution lines. The proposed 500 kV Kaiparowits transmission lines would add a severe additional impact to the existing visual quality of the area and further limit land uses. The pattern of the numerous rights-of-ways in the Banning Pass area has fragmented land ownership to such an extent, that remnant lands are often unusable by their owners (Illustrations III-13, III-14 and III-15).

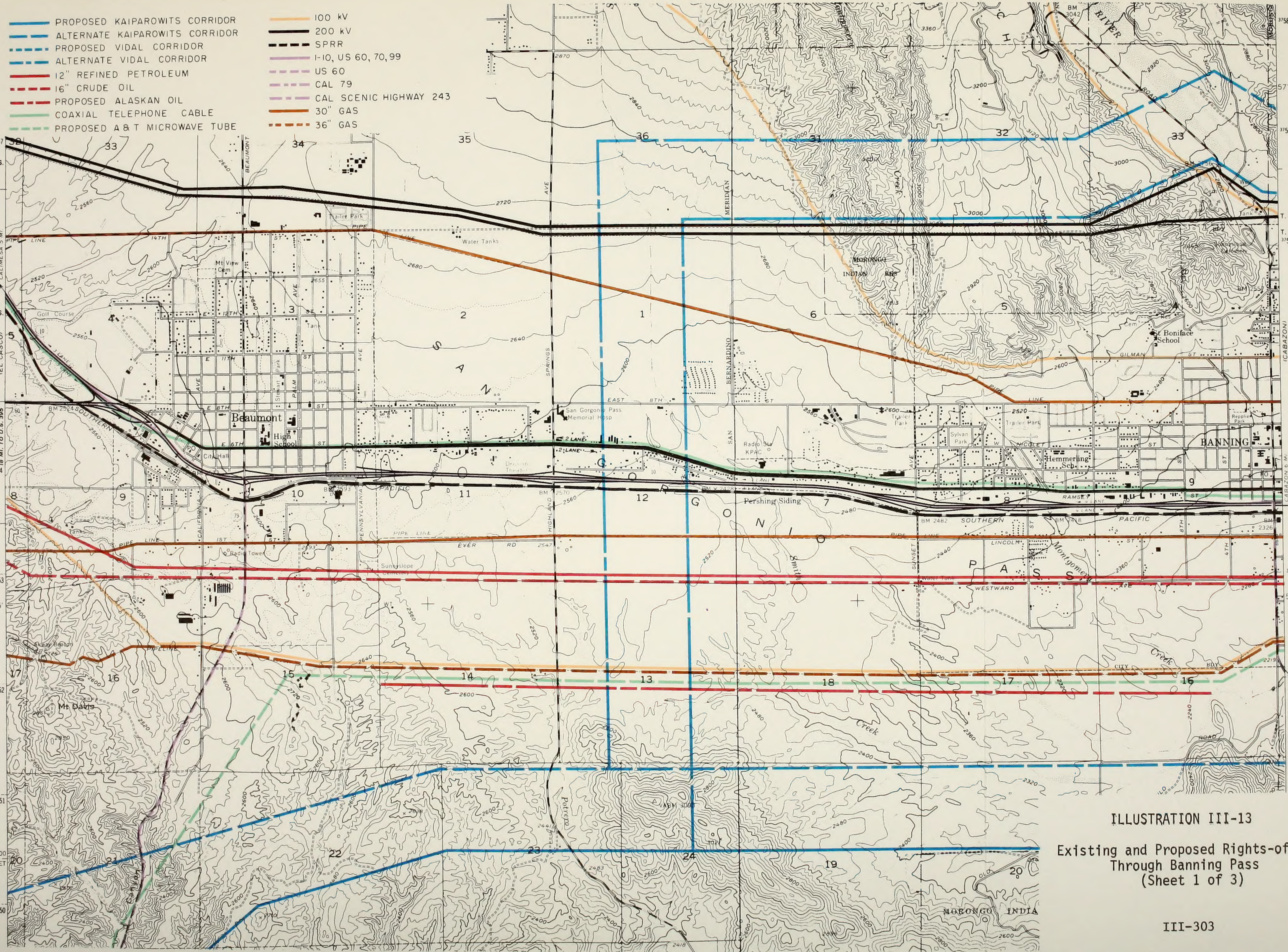


ILLUSTRATION III-13

Existing and Proposed Rights-of-Way Through Banning Pass (Sheet 1 of 3)

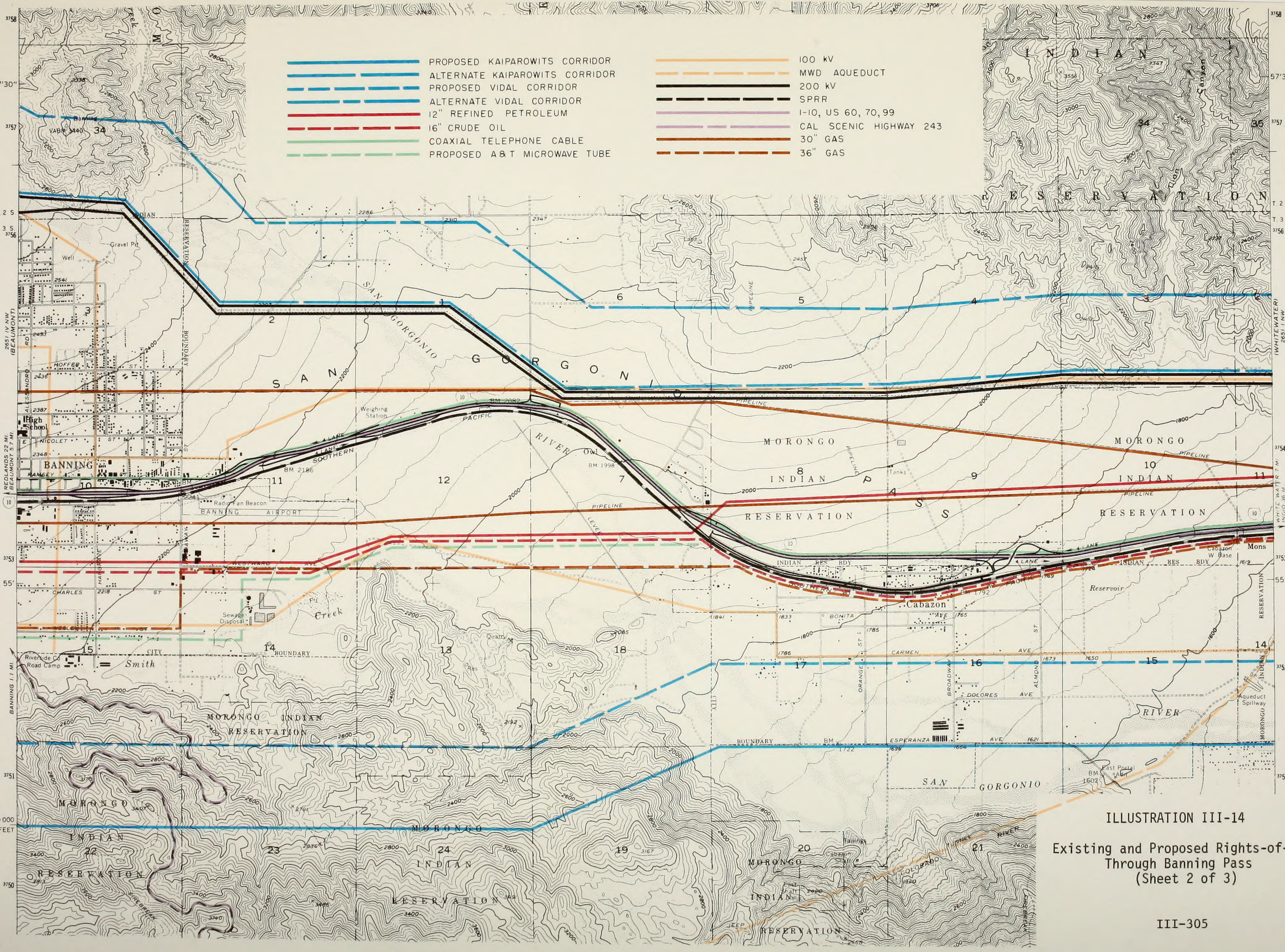


ILLUSTRATION III-14

Existing and Proposed Rights-of-Way
Through Banning Pass
(Sheet 2 of 3)

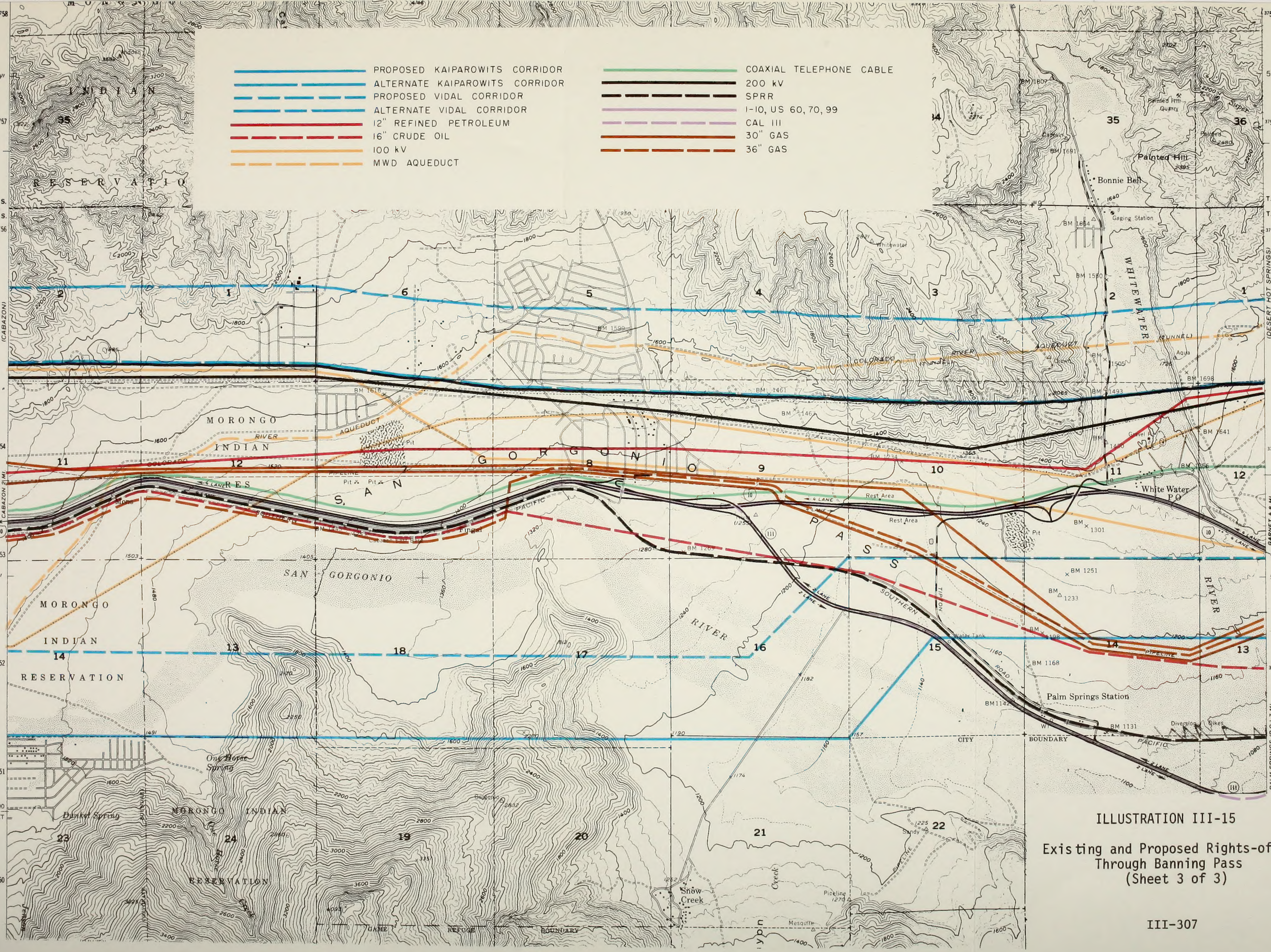


ILLUSTRATION III-15

Existing and Proposed Rights-of-Way Through Banning Pass (Sheet 3 of 3)

Impacts on existing roads would relate directly to increased use during construction and maintenance activities. Movement of heavy loads to construction sites on unimproved or light-duty roads would, in most cases, render them unsuitable for use by all but heavy-duty or off-highway vehicles. Considerable repair or upgrading would be required if roads were to be used after construction by the general public or for access by maintenance personnel. Soil erosion would be increased on these roads during construction (see Soils and Water Resources, Chapter III, for erosion and sediment yield).

The primary and northern proposed transmission systems would interfere with the aircraft glide path at the unrecognized airstrip located at Glendale, Nevada. The existing strip would have to be closed due to the construction of the proposed lines, resulting in local users being deprived of the facility and forcing them to seek another airstrip elsewhere. The California Wash proposal would not cause any such interferences and resultant closure.

All transmission system proposals could cause conflicts with the proposed airport for Eldorado Valley south of Las Vegas, Nevada. At this time the Eldorado Valley Airport proposal is strictly a proposal and it is unknown whether or not it will be built.

A report prepared by the participants (Southern California Edison, 1974) identifies potential interference with the proposed Eldorado Valley Airport.

> "That portion of the route between Miles 262 and 268 could be in conflict with plans for a proposed major air carrier facility (Eldorado Valley Airport). A 1972 study prepared by the firm Landrum and Brown, Inc. at the request of the Clark County Department of Aviation, shows several proposed locations for the airport, lying generally within the Eldorado Transfer Area between Eldorado Substation and Boulder City. Our preferred route should be about 1.5 miles southwest of proposed runways and would be directly in the flight path."

"It has been learned in a recent contact with the FAA by our Customer Service Department that the airport is still in the feasibility study stage and no specific site has been determined, although the plans are still to locate the airport in the Eldorado Valley Study Area."

Construction of the proposed lines would preclude airport location at a site where they would present a safety hazard to users.

Urbanizing areas

In the western California, Las Vegas, Bullhead City, and plant site areas, the proposed routes would impact urban or urbanizing land through loss to construction. Various forms of residential zoning currently or potentially exists in these areas. Additionally, residential property values would decrease in areas where visual quality might be reduced.

Residential zoning variability precludes quantification of property value reduction and acres lost to development. This situation occurs since some residential areas may not be needed for development in the foreseeable future, and loss in value to land from an aesthetic or visual quality standpoint is dependent on individual attitudes.

In western California the following communities and urbanizing areas would be adversely affected: Chiriaco Summit, Cactus City, Hidden Springs, Silverado, Thousand Palms, Seven Palms Valley, North Palm Springs, Whitewater, Cabazon, Lakeview Mountains, Romoland, Quail Valley, Canyon Lake, Meadowbrook, Alberhill, and Temescal Valley. Future zoning changes would probably be necessitated by construction of the proposed transmission systems in these urbanizing areas.

The microwave sites in and near the urbanizing areas would not have any further impact on adjacent urbanizing communities because there would be expansion of already-existing sites; new sites would have to be constructed only in the more remote areas.

The proposed transmission system would cross portions of the Agua Caliente and Morongo Indian reservations in California. The Agua Caliente Reservation contains approximately 25,500 acres and the Morongo Reservation about 30,000 acres. Assuming a right-of-way width of 330 feet, approximately 80 acres and 150 acres respectively, would be encumbered. Actual occupied areas for roads and towers would be much less. Present land uses would be allowed to continue. One land use that would be eliminated is homesite development; this has not been a use on the Morongo Reservation in the past due to extremely rough topography. The right-of-way across Indian lands would be a source of income to the reservations.

Limestone quarry impact area

Livestock grazing

Vegetation removal on the quarry site, shop, magazine and stockpile areas and access roads would eliminate about 160 acres of livestock forage. Approximately 64 cows per month (64 AUMs) of the 646 cattle presently grazing the areas would be displaced or the number would have to be reduced accordingly.

Should livestock watering sources (Prospect and Tom Best springs) be reduced or contaminated by the proposed operation, cattle may not be able to water in the area or sources unaffected by the project may have to be developed.

Mineral development

Should the proposed quarry operation be implemented, mineral development would become the major land use in this area which has had no mineral development except for scattered sand and gravel operations. The proposed operation would probably encourage additional future mining of limestone in Johns Valley or nearby alternate areas to supply other proposed coal mining or power project in southern Utah.

Better access resulting from the proposed operation would facilitate exploration for all types of minerals.

Wood products

Approximately 50,000 board feet of ponderosa pine, the only commercial tree species in the area, would be removed by the quarry operation. About 130 acres of pinyon pine, which is utilized as firewood, would also be destroyed by clearing operations prior to quarrying.

Agriculture

The several-hundred-acre agricultural operation near Widtsoe Junction would not be directly affected by the proposed operation. If irrigation water

from Tom Best Springs were contaminated or if discharge were severely decreased, the agricultural operation would possibly be terminated or other water sources developed.

Transportation facilities

There would be marked increases in heavy truck traffic along the proposed haulage route of the project. A higher probability of accidents along the rc[illegible] and decreased aesthetic values as well as increased noise and exhaust emissions would result.

The approximately 30 round trips per day (60 one-way trips) by the limestone trucks would be in addition to the current 40 trips per day by oil tankers along a portion of the route. The loaded limestone units would be traveling eastward while loaded oil tankers are going west. A traffic "bottle-neck" could result as they pass through the steep canyon segment of Highway 12 in the northeast corner of Bryce Canyon National Park. Possible safety hazards would relate to increased truck traffic through Tropic which now has Highway 12 traffic, and more especially Cannonville where the limestone trucks would leave the main highway and travel south through the town's main street. This street currently has minimal light vehicle traffic but would become the new highway. New road construction and upgrading of existing roads along the proposed haul route would improve highway transportation facilities in the area.

SOCIOECONOMIC FACTORS

Kaiparowits Plateau impact area

The participants' estimate of basic employment is contained in Chapter I. Basic employment generates "secondary employment." "Secondary" simply means jobs generated to serve the needs of basic employees. The product of basic employment would be exported from the area (in this case, the power would be exported to Arizona and California), whereas the product of secondary employment would be consumed by residents within the immediate area.

An "employment multiplier" is the average number of secondary and basic jobs expected to result from creation of the average basic job. Assuming that a new town will be established at the Glen Canyon City area, expected employment multipliers for three areas are shown in Figure III-62. The same table contains "dependent multipliers" for the same areas. A dependent multiplier is the average number of people dependent upon each job.

Population forecasts

Almost all plant and mine employees would reside in the new town planned for the Glen Canyon City area, or in Page, Arizona. Page would be expected to draw much of the housing and service market; however, expedient phasing in and of the new town would probably cause about 75 percent of these workers to live there, and 25 percent in Page. If development of the new town is delayed, or if quality of the new town facilities and the contingency plan facilities is low, Page might receive more than 25 percent of the population increase impact. It is expected that limestone quarry workers would live in Garfield County, provided facilities are available in one or more of the small towns in the area.

Figure III-63 shows expected population growth and distribution among communities. Of course, not all of the new population would live in just the three areas listed. A few would scatter to nearby locations. The number that scatter would be dependent on the timing and quality of the new town,

FIGURE III-62

Population Forecasting Multipliers
for Kaiparowits Employment

	Employment Multiplier		
	New Town	Garfield County	Page, Arizona
Year 1*	1.15	1.50	2.5
2	1.30	1.56	2.5
3	1.45	1.62	2.5
4	1.60	1.68	2.5
5	1.75	1.74	2.5
6	1.90	1.80	2.5
7	2.00	1.86	2.5
8	2.00	1.92	2.5
9	2.00	1.98	2.5
10	2.00	2.00	2.5

	Dependent Multiplier		
	New Town	Garfield County	Page, Arizona
Year 1	1.70	1.75	2.0
2	1.81	1.80	2.0
3	1.92	1.85	2.0
4	2.00	1.90	2.0
5	2.00	1.95	2.0
6	2.00	2.00	2.0
7	2.00	2.05	2.0
8	2.00	2.10	2.0
9	2.00	2.15	2.0
10	2.00	2.20	2.0

*12 months after construction begins

FIGURE III-63

Expected New Population

Distribution of Basic Employees

	New Town	Garfield County	Page, Arizona
Year 1	537	45	179
2	1,203	63	401
3	2,044	86	681
4	2,776	142	925
5	2,860	142	953
6	2,857	143	952
7	2,732	140	912
8	2,572	137	862
9	2,354	131	785
10	2,354	131	785

Expected Total Population

	New Town	Garfield County	Page, Arizona
Year 1	1,062	117	895
2	2,862	176	2,005
3	5,759	423	3,405
4	8,883	452	4,625
5	10,010	484	4,765
6	10,856	504	4,760
7	10,928	533	4,560
8	10,348	552	4,310
9	9,416	557	3,925
10	9,416	587	3,925

the same as has been discussed for the number that would live in Page. If the new town is developed as proposed, the three areas shown would be the centers of concentration for the new population. The figures show the total population increase that is estimated.

These projections are based on several assumptions. In order to arrive at the employment multipliers and these projections, a large number of factors were considered. The type of employment, the level of planning expected that could encourage growth, the possibilities of economic development in the communities, and other factors were included in the estimate process.

The Kaiparowits project would cause a change in current trends at Page. As construction at the Navajo plant is completed, Page could become primarily dependent on a recreation economy. However, with the Kaiparowits plant and a new community nearby, the decline in social and economic activity would diminish by the first year of the project and then resume a substantial growth rate. If the Kaiparowits project were not built, Page would decline in population in 1975 and 1976, and then resume a gradual growth rate, as shown in Figure III-64. Figure III-64 shows the expected population of Page with and without the proposed Kaiparowits project.

The number of school children that would be in these communities can be calculated by estimating the population percentage that would be in age brackets 5 to 14 for elementary students and 15 to 19 for secondary students. These percentages and the calculated expected new enrollment are shown in Figures III-65 and 66. Percentages for the new town, phase-in progressively higher because of the family structure expected there. During construction, many workers would be expected to live in bachelor facilities provided at the new town site. These workers would be replaced by mine and plant workers who would bring their families with them. Some construction workers would also be expected to begin living in bachelor quarters and then send for their families as soon as suitable housing is found. These and other factors were considered in the estimates.

FIGURE III-64

Expected Population At Page, Arizona

	Without Kaiparowits	With Kaiparowits	
Year 1	5,750	6,645	(1976)
2	5,781	7,786	(1977)
3	5,812	9,217	(1978)
4	5,843	10,468	(1979)
5	5,874	10,639	(1980)
6	5,905	10,665	(1981)
7	5,936	10,496	(1982)
8	5,967	10,277	(1983)
9	5,998	9,923	(1984)
10	6,029	9,954	(1985)

FIGURE III-65

Expected New Elementary Students

(Ages 5-14)

	Percentage of New Population		
	New Town	Garfield County	Page, Arizona
Year 1	9	23	23
2	11	23	23
3	12	23	23
4	15	23	23
5	18	23	23
6	19	23	23
7	20	23	23
8	20	23	23
9	20	23	23
10	20	23	23

	New Enrollment		
	New Town	Garfield County	Page, Arizona
Year 1	106	27	203
2	315	40	455
3	691	97	773
4	1,332	104	1,050
5	1,801	111	1,082
6	2,063	116	1,081
7	2,185	123	1,035
8	2,070	127	978
9	1,883	128	891
10	1,803	128	891

FIGURE III-66

Expected New Secondary Students

(Ages 15-19)

Percentage of New Population

	New Town	Garfield County	Page, Arizona
Year 1	3	11	11
2	4	11	11
3	4	11	11
4	6	11	11
5	7	11	11
6	8	11	11
7	10	11	11
8	10	11	11
9	11	11	11
10	11	11	11

New Enrollment

	New Town	Garfield County	Page, Arizona
Year 1	32	13	98
2	114	19	221
3	228	47	375
4	533	50	509
5	701	53	524
6	868	55	524
7	984	59	502
8	1,035	61	474
9	1,036	61	432
10	1,036	65	432

Housing

If the new town is developed as proposed, most plant and mine employees would probably reside in the new town or at Page. Page is expected to draw much of the housing and service market, but the expedient phasing-in of a town at the Glen Canyon City site might draw 75 percent of the housing market. This would create a need for 3,000 new housing units to be built within 5 years. Page has the advantage of being an established community and is near Lake Powell which offers recreation opportunities. One of the plans for the new town calls for it to be located at the junction where the road to the plant and mines intersect with Highway 89. If this site were chosen, workers would be expected to reside at the new town because it would be about 19 miles closer to the job than is Page. It is expected that the towns would compete for housing, and the new town would compete favorably with Page only if the housing were provided shortly after plant construction began.

Limestone quarry workers in Garfield County would create a demand for about 100 new housing units. Slightly more units would be needed if few of the residents already in the area obtain jobs at the quarry. If about one-fourth of the labor force were obtained locally, then 100 new units would be sufficient. Some residents of the area, and some private investors, have indicated an interest in constructing the housing, but no definite plans have been made. The need for 100 new units would not be a great need in comparison to the demands for housing that would occur at the new town, but this demand could have a significant effect on the environment. Towns in the area are small, there are many scenic assets, and trailer village restrictions to insure quality are minimal and poorly enforced. Should makeshift trailer villages be established in Garfield County to meet this need, area attractiveness could be permanently impaired. Planned, landscaped trailer villages in one or more of the small

towns, plus construction of some permanent housing, could meet the need and promote the economy without marring the landscape. However, there are no plans for these facilities. Most of these communities are economically depressed. Water in the Sevier River Drainage is fully appropriated and use by a new population would probably divert water from existing uses.

Planning for the power plant and mine has far exceeded planning and funding for the services and housing needed to accompany the industry; thus, adequacy of housing and services would depend on ability of planning to compensate for lost time. Recent accelerated efforts to compensate for this lost lead time may be adequate so that facilities at the new town would be provided as needed.

When heavy industry moves into an area such as Kane County, where population is low, it can strain the service sector. In some cases, the strain in boom town areas becomes so severe that it dominates the way of life. Inadequacy of services in boom town situations become much more than an inconvenience. It can contribute to marital strife as wives grow impatient with mud-spattered trailer living, it can contribute to political instability as community leaders realize they may be facing problems beyond their capacity to solve, and it can detract from community development as families look forward to finding better living conditions and employment elsewhere. The current level of planning for the new proposed town suggests that many problems associated with boom towns could be avoided, but avoidance of such situations can only be maintained with constant surveillance of impending problems, and securing adequate funding to prevent the growth of such problems. Unless proper control is maintained, Kane and Garfield counties would experience a disproportionate crime rate and other problems similar to those experienced in Campbell County, Wyoming, where boom town conditions caused a dramatic rise in problems (Figures III-67 and 68).

FIGURE III-67

Population of Gillette, Campbell County, Wyoming

Year	Gillette	Campbell County
1950	2,190	4,839
1960	3,580	5,861
1968	8,000	
1970	7,194	12,957
1971	7,200	
1972	8,000	
1973	9,000	

Source: Study by Dr. ElDean Kohrs

FIGURE III-68

Crime Rate and Social Problems, Gillette, Campbell County, Wyoming

	Campbell County over Goshen County Wyoming	Campbell County over Carbon County, Wyoming
Population	16% higher	3% lower
Divorces	85% "	33% higher
Arrests	204% "	67% "
Public Drunkenness	185% "	139% "
Driving While Under the Influence	350% "	350% "
School Drop Outs 1969-70	56% "	26% "
Criminal Budget	62% "	51% "

Source: Calculated from Dr. Kohr's study.

Rock Springs, Wyoming, also has been beset with one problem after another from the time it suffered an energy boom (Deseret News, November 5, 1975) "You don't know for sure what's going to happen until it hits you hard," said Major Paul Wataha. He also indicated that he thought Rock Springs had adequately planned for the population crunch before it hit his community. Recently, the largest amount of illegal drugs in Wyoming was confiscated in his community. (Provo Herald, November 2, 1975). Dr. Kohrs revealed that in the high growth counties of Wyoming, in contrast to the low growth counties, the percent of the population from which arrests were made is generally higher, the number of total arrests is higher, and the costs per person for criminal activities was higher in the growth counties. He referred to the "inordinate costs per capita and the increase in casualties...," in the area of mental health (Kohrs, 1975).

The financing problem for the proposed new town consists of obtaining funds for specific parts of overall community development, especially for housing, on an "as needed" basis. The various kinds of financial demands would include: trailer courts, office buildings, and single family housing. There is nothing unusual or innovative in this kind of financing; however, in a new town, in the early stages of development, a "critical mass" must be achieved. Slow pace is the enemy of new town development. All aspects of town life must begin to appear in the very early stages so that a credible momentum may be achieved. Each facet interacts and helps the development of others. Stores come because people are coming, people come faster because stores are there. More people come because additional jobs exist. This is the critical mass that allows a town to develop.

Securing investors and phasing-in construction in a time frame that would allow the greatest profit and greatest convenience for the residents may not occur. With proper planning and promotion for the new community, overbuilding could be avoided. The greater danger lies in under-building and being inadequately prepared for the projected population influx.

The average trailer home found in boom town developments is about 14 x 70 feet or 1,000 square feet. Including setup and delivery, the average cost is about $10,000. In addition, the owner must pay rental space, which varies in price according to amenities provided. The pay of the average plant and mine worker indicates they could afford much nicer housing than is available in most boom town situations. Families who live in makeshift trailer facilities typically seek to relocate to better facilities, when available, even though extra expense might be involved.

Services

Until the new town economy could become diversified, the well-being of people in the town would be almost exclusively dependent on events at the plant and mines since the new town would, in effect, be a company town. A strike, for example, would seriously affect the town economy. There is some recreation potential, but the town would have to compete with Page and the facilities near Wahweap Marina for this business. According to one plan, the new town, if developed, would become a junction point on Highway 89 with the road to the plant and mines. The town may also be at the junction of a planned road around the west shore of the lake. Thus, traveler services would add some economic growth and diversification.

If Page begins to feel the impact of the housing demand, some new housing starts would likely occur. However, housing and service demands would primarily be met with existing facilities. Even though population is declining in Page, the school board has expanded some facilities. This is partly because there is a need for vocational shops, better classrooms, and an auditorium, and partly due to anticipation of the Kaiparowits project.

Currently, a few students in Page reside in Kane County. In such cases, the Page schools charge Kane County a tuition fee to cover some of the

operational expenses. Page plans to continue this policy, and this policy could offset some of the initial demand for school facilities in the new town. Magnitude of the demand for educational facilities, however, would require new schools in a short period of time in the new town.

The project would necessitate building a new highway for construction and commuter purposes. The plans, including financing plans, are discussed in the new highway section of Chapter I. It is doubtful that the roads would be finished before they are needed and traffic may be on dirt roads for some time. The distance to the plant and mines from the new town and Page would create a need for mass transit facilities for commuter convenience and economy. No plans for such facilities have been made. Some workers might try to avoid commuting and seek to rent private lots for their trailers along the roadsides. There are very few private lots in the area, but wherever they exist (near Henrieville, Tropic, Cannonville, and on Highway 89), they may become occupied with makeshift trailer facilities. Facilities of this type would detract from the beauty of the surrounding countryside.

Medical facilities in the region might take care of new demands for a few years. When the Glen Canyon Dam was built, the Department of Interior required the prime contractor to build and operate a 24 bed hospital at Page which was turned over to the Department upon completion of the dam. It continues to meet the needs of Page. Many other facilities exist at Page (as outlined in Chapter II) that could be used by Kaiparowits employees.

Capacities of hospitals in southern Utah are as follows: Panguitch, 14 beds; Beaver, 10 beds; Kanab, 24 beds; and St. George, 39 beds. To improve the present situation, Panguitch is planning to build a new 14-bed hospital in 1976 to replace the old one. On the average, present medical facilities are only 50 percent utilized, but the expected long-term impact of the Kaiparowits project

would create a demand for new hospital facilities. The major impact anticipated in relation to medical services would be a shortage of doctors.

The existing law enforcement systems in the region seem to be adequately manned when compared to national standards, but salaries are far below those in Salt Lake City, and the quality may suffer accordingly. A higher turn-over rate among peace officers might occur because many may have new opportunities to work for private industry. Whenever public service employees have opportunities and the necessary training to accept employment in nearby private industry, the turn-over rate can be expected to increase. This applies for law enforcement personnel as well as for others.

In addition to creating new demands for specific service sectors, industrial development in Utah would contribute to ongoing urbanization and America is seriously short of ideas and methodology for dealing with adverse effects of the urbanization process. The need to avoid urban degradation is particularly critical in south-central Utah, because it is a scenic area relatively untouched by problems that accompany urban development.

Zoning law and regulation has been the method used most often in the U.S. to insure community aesthetics. However, zoning is only a partial answer at best and has some serious detrimental side effects. Zoning in America was established as an attempt to separate industry from residential areas. This land-use segregation philosophy grew until a multitude of land-use alternatives were itemized and coded with the intention of assigning each use to separate areas. An unfortunate by-product of this process was the acceptance of aesthetic deterioration. Rather than expecting market and industrial areas to be attractive, they were, in effect, zoned "ugly." Runaway aesthetic deterioration was tolerated in areas not zoned residential. Even with some zoning regulations, the proposed new town and sites along Highway 89 might become aesthetically displeasing to some residents and tourist travelers far beyond that reasonably necessary to promote commercial activities.

A wide variety of services would be needed at the new town, and some would be needed sooner than others. For example, construction of schools and parks would be a critical need within a few years after construction of the plant begins; whereas, construction of some commercial facilities would not be as critical a need because of the nearby facilities at Page. Careful phasing-in of the facilities as needed would keep the service lag at a minimum.

Impacts of the new town

If developed, the Kaiparowits new town would be the first and largest new town built in the Western United States in recent years. It would also be among the first to be developed by a local political agency. Previously, new towns have been the province of developers. The proposed Kaiparowits new town would be somewhat unique because it is planned in an area of limited water supplies, and comparatively isolated. It would be unique because its full blown operation would entail a new socioeconomic composition being placed upon the existing sociological scene. Furthermore, its inception and continuance will mean the cultural life of nearby residents would be severely challenged by the influx of large amounts of people with different cultural values. Finally, this town would be unique because its development and continuance may very well constitute a political baseline change. A large block of voters in this town could control local and regional destinies. The new town could become the locus of voting power within the county. Furthermore, because of a potential difference in political orientations, it is legally possible that the new town could become the county seat of Kane County - if not of its own newly created county.

Some additional reasons for concern about this community are that "In new cities, nobody is an expert. We're all learning." (op. cit., p-68). Also, at least initially, it would be a company town. The economic life line of this community would be its dependence on one project. Even though 35 years

is not all the total planned life of the generating plant, it is conceivable that all coal would be extracted in that general time frame.

The state initiated planning activities by establishing the County Service Area Act. This act gave the service area basically the same zoning, planning and legal rights as an incorporated community. To further assure that future planning would not be haphazard, Planned United Development legislation was passed, to allow the creation of new towns to be completely planned and approved by County Planning Commissions. Ultimately, the Kaiparowits Planning and Development Council was established by Executive Order of the Governor for the express purpose of planning and developing the Kaiparowits new town in addition to overseeing other industrial development activities within the Kaiparowits area. The council has been actively engaged in the ultimate development and operation of the new town (Kaiparowits New Town Study, 1972; and letter from Merrill R. MacDonald, Chairman, to the Kaiparowits Planning and Development Council, dated March 21, 1975).

One study indicates that at this early date it cannot be determined whether or not (at least in the case of one new community, Reston, Virginia) the "new community" offers a better, richer, and fuller residential environment than other alternatives (Zehner, et al., 1974). In the early stages of their development, new communities are dependent upon a logical relationship with supporting socio-political subdivisions (Kelly, 1975). These levels of dependency and impact problems which may arise have not been studied in great detail, but it is known that planners expectations of a continuing supportive relationship often are not met (Gulf-Reston, Inc., 1973). Subject areas such as sewers, zoning, roads, schools, and parks have caused problems regarding the survival of the new communities (Kelly, 1975). New towns may change the concepts and expectations of impact area residents, and this can result in severe problems to the community, county, and state (Kelly, 1975; and Zehner, 1974).

In the case of one new community, Reston, Virginia, after 20 + years the social impacts, economic problems, etc., land clearing, aesthetic scars, boundary adjustments, temporary facility shortages, storage and oversupplies, and institutional expansion are still a part of the community (Kelly, 1975).

If a new community becomes a part of the social system, then a change in one part of the system affects all other parts of the system. Thus, if people in the county and the community become unemployed because of their mutual attachment to one employer whose presence originally necessitated the new community, then the county suffers the economic burden. The same is true of environmental health problems, law enforcement problems, infectious diseases, pollution, protection and preservation of farms, ranch lands, and scenic attractions. The principle of social system dependencies is seldom fully appreciated by planners.

To develop a system of financial bonding to support the development of a community may be financially defensible, but it is not sociologically or economically defensible to assume that such actions will alleviate the mutual responsibilities of the county, or the state. To put it simply, the Kaiparowits new town and supporting power plant may become socioeconomic liabilities to the county and the state.

In the case of Reston, Virginia which is one of the largest planned communities in the United States (and in a comparatively populous area), "Reston has become the victim of its own impact. Various court decisions...have made...and complicated... its impacts." Indeed, the Reston developers may drop the project before completion. This is not to imply that at this time, there is not a favorable balance of revenue to costs in Reston (Kelly, 1974). Because problems of cluster housing, common ground provision, homeowners associations, special interest groups, commuter busing, and fees for leisure time activities such as golf, tennis, parks, horse back riding, are not amenable to controls - new socioeconomic burdens accrue.

It is very possible that, as planned, Kane County services could become centralized in the new community. Further, it is possible that new problems of sewers, streets, lighting, and garbage collection would occur in other cities around the new community such as Glen Canyon City. There are numerous other areas contiguous to the planned city where this could, and following national precedent, would occur, (Kaiser Engineers, 1975).

Schooling, instructional philosophies, busing, intermingling of county and new community school children via new school programs and techniques constitute another unplanned area of impact. There would undoubtedly be school divisions. Social status characteristics associated with parental and geographical backgrounds, whether or not they are planned for, would arise.

Impact on plateau area communities

It is difficult for a socioeconomic assessment (based on documentary data) to convey an impression of the small communities within a 75 mile radius of the proposed Kaiparowits power plant and planned new town other than the image that they are very susceptible to 1) major internal changes, and 2) that the changes would relate to other community and regional social pathologies (Lynd, 1929; West, 1945; Effrat, 1973; Henry, 1958). There are many reasons for these predictions: 1) the communities are small, population wise, ranging in size from approximately 100 to 2,000; 2) the communities have established rural traditions (Minar, 1969; Hillery, 1955); 3) the communities have established religious foundations (refer to Chapter II); and 4) the communities are comparatively isolated.

Communities such as those in the vicinity of the proposed power plant site have been described as "communities as societies" and "personal communities" (Neuwirth, 1969; Effrat, 1973). These communities tend to be oriented around family and extended family maintenance. There is a high degree of consciousness

of kind, and participation in informal and formal organizations which tend to be oriented around family and extended family maintenance, and shared subculture identification.

It is very conceivable that subcommunities based on ethnic and racial lines could develop in the overall area (Kramer, 1970; Breton, 1964). Occupational and professional groups would subdivide as urbanization occurs, (Goode, 1957) and clashes would develop because of differences in cosmopolitan and local social ties (Warren, 1963).

There could be a tension between residents who attempt to maintain "closure" (i.e., maintain established and traditional sociological patterns) and people who have special interests and/or interests in socioeconomic and political factors beyond existing community parameters (Effrat, 1973; Stein, 1960; Warren, 1963). To the extent that outsiders participated in numerous special interest groups, in opposition to traditional life styles, further disruptions would occur. Finally, newly elected representatives may lead into further strains by taking actions and involving themselves in political issues which are not directly oriented towards the interests of the native local community.

Generated revenue

Property tax revenues (Figure III-69), that would be generated by the plant, mines, and new town would make Kane County one of the richest counties in the state in assessed valuation. These taxes could be enough to support the provision of quality services, if a critical backlog of service problems was not created by a sudden population influx. It has proven to be much more expensive to correct service problems than to anticipate and prevent them.

Revenues generated in state taxes would also be substantial and would offset some needed state government expenditures. However, timing is critical and lack of an adequate implementation schedule would cause residents to undergo hardships until services become available. Figures III-70 through III-77 show

FIGURE III-69

Estimated Property Tax Revenues for Kane County[a]

	Plant	Mine	New Town	Total
Year 1[b]	$ 815,400		$ 100,000	$ 915,400
2	1,630,800	$ 380,520	500,000	2,511,320
3	2,718,000	869,760	1,000,000	4,587,760
4	4,892,400	1,304,640	2,000,000	8,197,040
5	7,338,600	2,011,320	3,000,000	12,349,920
6	11,198,160	2,609,280	3,500,000	17,307,440
7	14,677,200	2,609,280	3,500,000	20,786,480
8	16,308,000	2,609,280	3,500,000	22,417,280
9	17,667,000	2,609,280	3,500,000	23,776,280
10	18,754,200	2,609,280	3,500,000	24,863,480

[a]Additional information on the calculation procedures is presented in the Appendix, II-25

[b]Twelve months after construction begins.

FIGURE III-70

Estimated Property Tax Revenues For Garfield County From Limestone Quarry

Year 1*	$ 36,720
2	45,590
3	45,590
4	105,820
5	105,820
6	105,820
7	105,820
8	105,820
9	105,820
10	105,820

* Twelve months after construction begins

FIGURE III-71

Estimated Sales Tax Generated

	State of Utah	Kane County
Year 1*	$ 46,503	$ 5,748
2	118,370	14,630
3	213,378	26,373
4	311,723	38,528
5	340,648	42,103
6	380,475	47,025
7	383,368	47,383
8	363,343	44,908
9	331,748	41,003
10	331,748	41,003

* Twelve months after construction begins

FIGURE III-72

Estimated State and Local Share of Federal
Coal Lease Royalties
(in dollars)

	Kane County Highways	Lower Education	Colleges Universities	Total
Year 1*				
2	$ 7,407	$ 32,222	$ 34,444	$ 74,073
3	16,931	73,650	78,730	169,311
4	25,396	110,476	118,095	253,967
5	39,153	170,317	182,063	391,533
6	50,793	220,952	236,190	507,935
7	50,793	220,952	236,190	507,935
8	50,793	220,952	236,190	507,935
9	50,793	220,952	236,190	507,935
10	174,150	757,553	809,797	1,741,500

* Twelve months after construction begins

FIGURE III-73

Estimated Royalties From Coal on State Lands

Year 1*	-
2	$ 27,562
3	63,000
4	94,500
5	145,687
6	189,000
7	189,000
8	189,000
9	189,000
10	756,000

* Twelve months after construction begins

FIGURE III-74

Estimated Total Use and Sales Tax on Materials Used in Construction of Mines, Plant, and New Town

Year 1*	$ 2,742,000
2	3,370,000
3	5,860,000
4	10,845,000
5	12,092,500
6	18,645,000
7	16,970,000
8	12,600,000
9	7,310,000
10	5,180,000
11	2,030,000
12	1,010,000

* Twelve months after construction begins

FIGURE III-75

Estimated Total Franchise Tax on Plant, Mine and Expected Corporation in New Town

Year 1*	$ -
2	250,000
3	750,000
4	1,000,000
5	1,500,000
6	2,000,000
7	2,500,000
8	2,750,000
9	3,000,000
10	3,000,000
11	3,000,000
12	3,000,000

* Twelve months after construction begins

FIGURE III-76

Estimated Generated Income Tax

	State	Federal
Year 1*	$ 320,708	$3,527,788
2	759,714	8,356,854
3	1,312,684	14,439,524
4	1,814,741	19,962,151
5	1,884,825	20,733,075
6	1,942,803	21,480,833
7	2,113,845	23,252,295
8	1,630,913	17,940,043
9	1,439,445	15,833,895
10	1,439,445	15,833,895

* Twelve months after construction begins

FIGURE III-77

Estimated Federal Share of Federal Coal Lease Royalties

	52.5% Reclamation Fund	10% Administration	62.5% Total Federal Share
Year 1*	$ 103,703	$ 19,753	$ 123,456
2	237,037	45,150	282,187
3	355,556	67,725	423,281
4	548,149	104,409	652,558
5	711,112	135,450	846,562
6	711,112	135,450	846,562
7	711,112	135,450	846,562
8	711,112	135,450	846,562
9	2,438,100	464,400	2,902,500
10	2,438,100	464,400	2,902,500
11	2,438,100	464,400	2,902,500
12	2,438,100	464,400	2,902,500

See Figure III-28 for State share.

* Twelve months after construction begins

estimates of local, state, and federal revenues that would be generated should the proposal be approved.

The financial impact on Page would allow it to resume a former level of activity, approximately the same as it was in 1974.

The impact of expenditures in the private sector can be estimated by using a profile of average personal expenditures in the United States. Figures III-78 and III-79 show how these expenditures would be divided in different categories in southern Utah and in Page. However, lack of local opportunity to purchase desired goods and services would cause monies to be spent elsewhere (possibly in Las Vegas and Phoenix).

Public opinion

To gain more information about the publics opinion on the proposed Kaiparowits project, the Bureau of Land Management had a public opinion poll taken. The poll was conducted from June 20 to June 28, 1974. It is useful in determining peoples' opinions about the proposed project. More important, it gives an indication of how public opinion would be impacted by a decision on the project. However, by the time a decision is made on the project, the poll will be approximately 2 years old. Public opinion may change in that length of time. Therefore, the poll is included in Appendix III-14, but not in the body of the statement.

FIGURE III-78

Estimated New Personal Expenditures in Southern Utah

	Total	Housing etc.	Food etc.	Clothing	Trans- portation	Medical	Personal etc.
Year 1*	$ 9,541,000	$ 2,767,000	$ 2,481,000	$ 954,000	$ 1,240,000	$ 572,460	$ 1,527,000
2	23,164,000	6,718,000	6,023,000	2,316,000	3,011,000	1,390,000	3,706,000
3	41,002,500	11,890,725	10,660,650	4,100,250	5,330,325	2,460,150	6,560,400
4	58,945,500	17,094,195	15,325,830	5,894,550	7,662,915	3,536,730	9,431,280
5	63,488,500	18,411,605	16,507,070	6,348,850	8,253,505	3,809,310	10,158,160
6	69,150,000	20,054,000	17,979,000	6,915,000	8,990,000	4,149,000	11,064,000
7	68,928,000	19,989,000	17,921,000	6,893,000	8,961,000	4,136,000	11,028,000
8	65,375,000	18,959,000	16,998,000	6,538,000	8,499,000	3,923,000	10,460,000
9	59,640,000	17,297,000	15,506,000	5,964,000	7,753,000	3,578,000	9,542,000
10	59,640,000	17,297,000	15,506,000	5,964,000	7,753,000	3,578,000	9,542,000

* Twelve months after construction begins

FIGURE III-79

Estimated Kaiparowits Related Expenditures in Page, Arizona

	Total	Housing etc.	Food etc.	Clothing	Trans-portation	Medical	Personal etc.
Year 1*	$ 3,148,000	$ 913,000	$ 818,000	$ 315,000	$ 409,000	$ 189,000	$ 504,000
2	7,644,000	2,217,000	1,987,000	764,000	994,000	459,000	1,223,000
3	13,531,000	3,924,000	3,518,000	1,353,000	1,759,000	812,000	2,165,000
4	19,452,000	5,641,000	5,058,000	1,945,000	2,529,000	1,167,000	3,112,000
5	20,951,000	6,076,000	5,447,000	2,095,000	2,724,000	1,257,000	3,352,000
6	22,820,000	6,618,000	5,933,000	2,282,000	2,967,000	1,369,000	3,651,000
7	22,746,000	6,596,000	5,914,000	2,275,000	2,957,000	1,365,000	3,639,000
8	21,573,000	6,256,000	5,609,000	2,157,000	2,805,000	1,294,000	3,452,000
9	19,681,000	5,707,000	5,117,000	1,968,000	2,559,000	1,181,000	3,149,000
10	19,681,000	5,707,000	5,117,000	1,968,000	2,559,000	1,181,000	3,149,000

* Twelve months after construction begins

Transmission system impact area

Most project-related social and economic impacts in the four-state region would appear to be of short-term duration. No more than 180 men would report to a single job site during peak construction periods along any of the four line segments. This would occur twice along the Mohave to Serrano segment. No more than 20 men would be working at a single structure site. The work population would be transient in nature. Construction of each segment would take approximately 1 year to 24 months depending on the length of the line. Construction time at any one tower site would be from 1 to 4 weeks.

Beneficial impacts would accrue from employment associated with the project. The greatest benefit would go to the locations where materials for the system (conductors, towers and hardware) are purchased and the cities from which the contractors would originate. Little or no on-site hiring would be expected except in areas where the proposed transmission lines would cross Indian reservations. The grants made by Indian tribes would require that a certain number of Indians be employed in construction activity on the reservations. Wages would be comparable to that paid non-Indians. Also, tribes would receive yet to be negotiated fees for granting rights-of-way across reservations.

There could be a slight increase in local employment through longer hours for service-oriented businesses accommodating construction workers at various communities along the routes. The need for necessities such as foodstuffs, clothing, miscellaneous hardware articles and auto services would increase from construction worker influx along any one segment of transmission line. The benefit would accrue to local business employment. No employment opportunities would be expected from operational aspects of the transmission system.

Impacts on services would probably be evident. Influxes of construction crews may impact localized areas as transmission lines are erected. Tourists may be inconvenienced by full motel rooms and congestion at restaurants and stores.

Based on past experience, it is estimated that along any one segment, there could be 45 to 90 workers who would stay in local hotels or motels. This could have a great effect on travelers who expect to stop over in the congested area. The congestion at restaurants, stores and service stations would not be as adverse as at places of lodging but would still be quite discomforting. Costs of services, food and other items may increase if a shortage develops, but would normalize after construction is complete. Indigenous low-income families would become further depressed due to the greater competition for income and housing.

Salaries for workers on construction projects on this nature usually average $25,000 to $35,000 a year. However, since the workers generally maintain two households, with the worker in a motel or house trailer while his family lives elsewhere, there would be considerably less spending power in towns and cities along the transmission route than salaries would indicate.

Any public facilities such as the few hospitals along the route could be over-taxed in case of on-the-job accidents. Concentrations of workers pursuing leisure time activities during off-duty hours may cause problems for law enforcement officials. In small communities, the end of a day's work might cause traffic tie-ups until the workers reach their place of lodging.

There would be a direct beneficial effect in county taxes and government land rental from the transmission system. These would be minor impact (dollar benefits) but they would occur mainly in areas where maintenance costs by county and federal government are going up and revenue returns are small. In the heavily urbanized areas, these additional revenues would be less significant. After construction, the transmission line and related facilities would be assessed for receipt of taxes by the counties involved. Since counties would not have to supply services to benefit the operation of the transmission system, revenues might be used to meet other local government needs.

Impacts on culture and attitudes along the transmission system would be quite varied. Most attitudes within the Utah, Arizona and Nevada region favor growth. Residents of this area accept the development as an indication of betterment of their own physical, cultural and financial well being. Not all residents are of this belief, and a minority might object to the proposed transmission system.

Nonresidents tend to be more opposed to the proposed transmission system, especially for remote areas where these people want to find nondevelopment and un-interrupted natural vistas. The paradox is that most are out of state residents or city dwellers in the energy receiving load centers. The impacts to this segment of society are that undeveloped areas are violated but the non-residents continue to receive an uninterrupted supply of electrical energy at their homes and places of employment.

As previously discussed in Chapter II, there are several Indian tribes who want their land to remain in a natural state. Powerline construction, therefore, would have detrimental impacts on their traditional religious beliefs and customs. The overriding issue is that Indian peoples wish to guide their own future. There is no way to predict how the project would culturally impact Indian tribes. They may choose to reject the passage of transmission lines across their lands by not authorizing right-of-way grants.

In areas where transmission routes would impact desert communities, there is strong sentiment against man-made disturbances, roads, powerlines, mines, factories, etc.. This is especially true where the skyline is impacted or background hills are disturbed in some way. Feelings run strong that the desert environment is quite fragile and must be protected from all unnatural intrusions. Therefore the impact of Kaiparowits on cultural attitudes could be significant.

Limestone quarry impact area

In general, socioeconomic impacts set out in the Kaiparowits Plateau area section, particularily problems of population increase, educational facilities, law enforcement, and sociopolitical structures, would also be applicable to the limestone quarry impact area.

If the new highway is built, there would be an increase in retail trade activities in the Cannonville and Bryce Valley area, which would necessitate business and new residential construction. Such an impact would possibly be beneficial and not too disruptive of area life styles. However, when combined with the contemplated population growth in the immediate region, the effect of the new highway on transportation patterns would create severe social change impacts on the communities of Cannonville, Tropic, Henrieville, and further north, on such communities as Widtsoe.

As indicated in Chapter I, in terms of truck loads, at least 30 limestone quarry to power plant round trips would occur daily. At least 130 men would be required to work in the quarry. If new mines and/or new power plants are developed in the area, critical socioeconomic impacts could occur. As indicated earlier, water facilities in local communities are not adequate now from an environmental health viewpoint (Goode, 1970). Additional population, would create additional tax burdens and social and cultural impacts. There is no known master plan which indicates a concern for this problem. Similarly, it is conceivable that traffic flows southward would have some effect on retail activities in the Glen Canyon City area.

IMPACTS IN THE MARKET AREA

Description of the service area

In this section, effects of the Kaiparowits project on the service areas are discussed. The primary concern is with likely impacts of more available electricity on the process of growth and urbanization. More specifically, the focus will be on three aspects of urban life as indicators of overall impact: open space (parks and recreation), pollution, and transportation. There are no definitely identifiable impacts that can be directly attributed to the Kaiparowits project by itself. Energy needs and demands are not discussed in this section since they are dealt with in the Need for proposed action section of Chapter I and in Appendix I-1.

One important qualification has to be made in this section. As of December, 1975, 18.6 percent of the capacity from Kaiparowits was uncomitted, that is, 458 megawatts. At this time, the participants stated there is no good indication of where that electricity might go. Therefore, there is no way to determine what impacts that 458 MW would have. Increased availability of electricity would influence pattern and intensity of population growth. Population is expected to grow in the service area and any increase in available electricity would facilitate that growth. Continued growth would impact open space, pollution abatement, transportation, and other urban needs. The growth pattern itself is part of the impact of providing energy, thus those patterns are described in this section.

Thirteen California counties and a small part of Nevada lie within the Southern California Edison (SCE) service area. San Diego Gas and Electric (SDG&E) serves almost all of San Diego County and the southern portion of Orange County. The area varies from mountainous country around the Sierra Nevada in Inyo and Mono Counties to the dry desert of San Bernardino and Riverside Counties (Illustration III-16).

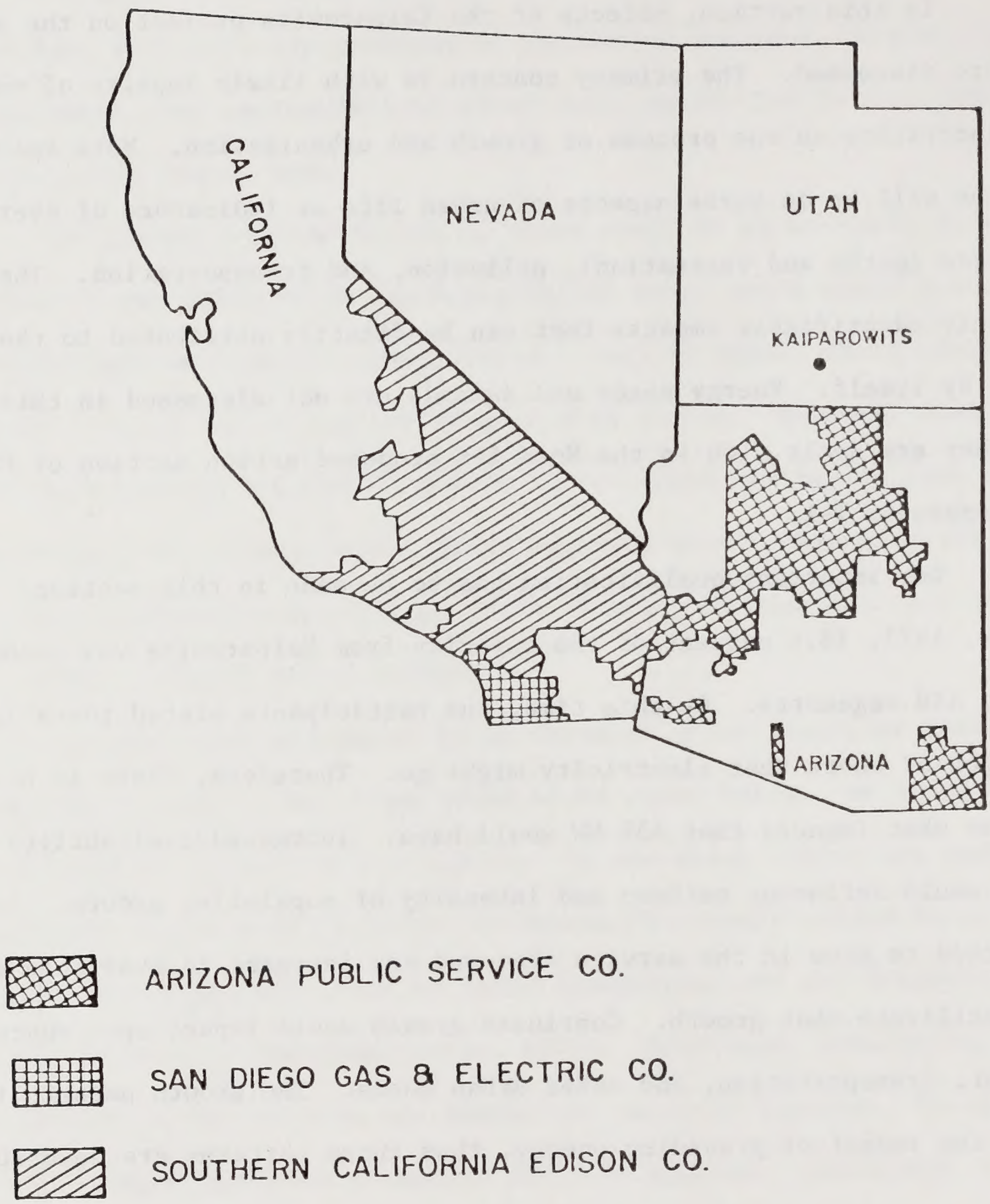


ILLUSTRATION III-16

Kaiparowits Project Participants Service Territories

However, it would be an exaggeration that the Kaiparowits Project would exercise a significant impact over the enormity of this entire area. Some counties within the service area are sparsely populated; others are serviced by another utility as well as by SCE (see Figure III-80). The Kaiparowits project would have far more significant impacts on counties within the "main impact area" counties as these contain 93.4 percent of the people within the total service area, as shown in Figure III-81. In addition, San Diego County, served by SDG&E, would likely be affected by the project as it also represents a sizeable population.

The population of the Phoenix Standard Metropolitan Statistical Area Flagstaff, and Yuma accounts for more than 80 percent of the population served by Arizona Public Service (APS). This is the market impact area in Arizona considered here, but the entire market area is shown in Illustration III-14.

Figure III-82 shows the shares of Kaiparowits electricity as a percentage of company demand estimates.

Some 90.9 percent of the people in California live in urban areas with 98.8 percent of the inhabitants of Orange County, 98.7 percent of the inhabitants of Los Angeles County, and 93.5 percent of the inhabitants of San Diego County living in urban areas. The state's patterns of population density and urbanization are also reflected by the amount of land recently taken out of agricultural production. In the five years from 1964 to 1969, California experienced a net loss of 3.5 percent of its farmland to other purposes, but Orange County lost 24.3 percent of its farmland and San Diego County lost 11.5 percent.

A high rate of migration into southern California during the past decade accounts for this increasing urbanization. From 1960 to 1970, California experienced a 13.4 percent net increase from migration. During this same period, Orange County had a net increase from migration of 78.3 percent, and Ventura County 66.2 percent. Thus, while Los Angeles County held fairly steady, with a

FIGURE III-80

Population Growth and Distribution in Impact Area by County Served by SCE and SDG&E

County	Population density per square mile	1970 Population	1950 Population	Increase (%)
Los Angeles	1,730	6,993,371	4,151,687	68.4
Orange	1,817	1,409,359	216,224	551.8
Riverside	64	449,878	170,046	164.6
San Bernardino	34	672,163	281,642	138.7
San Diego	319	1,351,135	556,808	142.6
Ventura	203	374,520	114,647	226.7
County totals		11,250,426	5,491,054	104.8
State total	128	19,957,715		

Source: 1970 Census

FIGURE III-81

Counties Within The SCE Service Area (1970)

County	County population as a percentage of total population in SCE service area		
Los Angeles	56.4	93.4%	Main Impact Area
Orange	17.8		
San Bernardino	9.6		
Ventura	5.6		
Riverside	4.0		
Tulare	2.4		
Santa Barbara	2.3		
Kern	1.1		
Kings	.4		
Nevada (state of)	.2		
Fresno	.1		
Inyo	.1		
Mono	.1		
Imperial	.003		

Source: System Forecasts: 1973-1995 (Southern California Edison), p. II-6

FIGURE III-82

Kaiparowits Electricity Demand Estimates by Company

Company	Kaiparowits Output (MW)	Peak Demand Expected From Kaiparowits 1981 (%)	Peak Demand Expected From Kaiparowits 1983 (%)
Arizona Public Service Company	540	16	14
San Diego Gas & Electric Company	702	22	19
Southern California Edison Company	1,200	7	6

Source: Calculated from participants' estimates

net increase from migration of only 4.2 percent, its neighbors to the south and north registered large increases. Other areas in southern California may eventually become as densely populated as Los Angeles and Orange Counties.

There are many conflicting projections concerning population growth in California; unfortunately no single estimate is clearly more authoritative than any others. However, a birth rate somewhere between 2.1 and 2.5 births per woman of childbearing age is likely, and an annual net migration of 100,000 into the State appears probable.

Projected patterns of population growth throughout the southern California area are currently in a state of flux. There is no agreement over the expected population growth during the next 20 or 30 years. Due primarily to changing social attitudes concerning the desirable number of children per family and the role of women in society, population projections of only a few years ago have been revised. Figure III-83 indicates the series currently used by the California Department of Finance, the California Public Utilities Commission, the Rand Corporation, the Southern California Association of Governments, Southern California Edison, and the SDG&E. As noted, there is wide variance between these projections.

Urbanization is a phenomenon that is familiar to contemporary America, and especially to southern California. The most noticeable, and probably the most important, national demographic trend of the post World War II era is the increasing concentration of people in urban areas. This has produced a decrease in the population percentage that lives in small towns or rural areas; fewer and fewer people escape the influence of urban life.

Within urban areas there is typically a separation between place of residence and place of employment. Nowhere is this of more consequence than in southern California. The enormous degree of reliance upon automobiles has had a

FIGURE III-83

Population Projection for 1990 by County

	Los Angeles	Orange	Riverside	San Bernardino	San Diego	Ventura
DOF[a] #1	7,347,000	2,465,000	756,000	914,000	2,242,000	704,000
DOF[a] #2	6,571,000	2,195,000	681,000	826,000	2,044,000	602,000
SCAG[b] #1	7,701,000	2,240,000	765,000	1,065,000		835,000
SCAG[b] #2	7,452,000	2,074,000	700,000	911,000		643,000
SCE[c]				917,000		770,000
SDG&E[d]					2,242,000	

[a] California Department of Finance
[b] Southern California Association of Governments
[c] Southern California Edison
[d] San Diego Gas and Electric

major impact on the character of the area. For example, Los Angeles County alone has more than 20,000 miles of highways and streets.

In southern California, the urbanization process has been dominated by sprawl to avoid the extremely high-density living found in many other urban centers. In this sense southern California has been suburbanizing and not urbanizing. Subburban life has many of the attributes of the urban life style mentioned above, but it is characterized by a higher percentage of single-family homes and a desire for lower population density than is found in central city areas.

Southern California, especially the Los Angeles area, never developed a high density core area surrounding industry and commerce that provided employment. Los Angeles epitomizes the post-automobile urban pattern spreading over an entire region. Despite their large population, both the Los Angeles and San Diego regions have a lower population density (people per square mile) than most metropolitan centers in the nation. Los Angeles County covers 4,069 square miles and San Diego is spread over 4,261 square miles.

Whatever level of population growth that occurs in southern California, it is expected to contribute to the outward movement. No largescale migrations back into the "downtown" or "central" areas are foreseen. The suburban growth of the last two decades took place in areas that were either agricultural or previously barren, but now habitable because of imported water supplies. There is no indication of any change in the pattern of sprawl.

Within the six county high market impact area in California, responsibility for the performance of local governmental functions is quite fragmented. Some cooperation between these governmental entities can be seen. In fact, cooperative arrangements are common and southern California has been a pioneer in the so-called "Lakewood Plan" whereby independent cities and special districts contract with another governmental entity, usually the county, for certain services. Some

planning may take place at a regional level, but political control remains highly decentralized and fragmented.

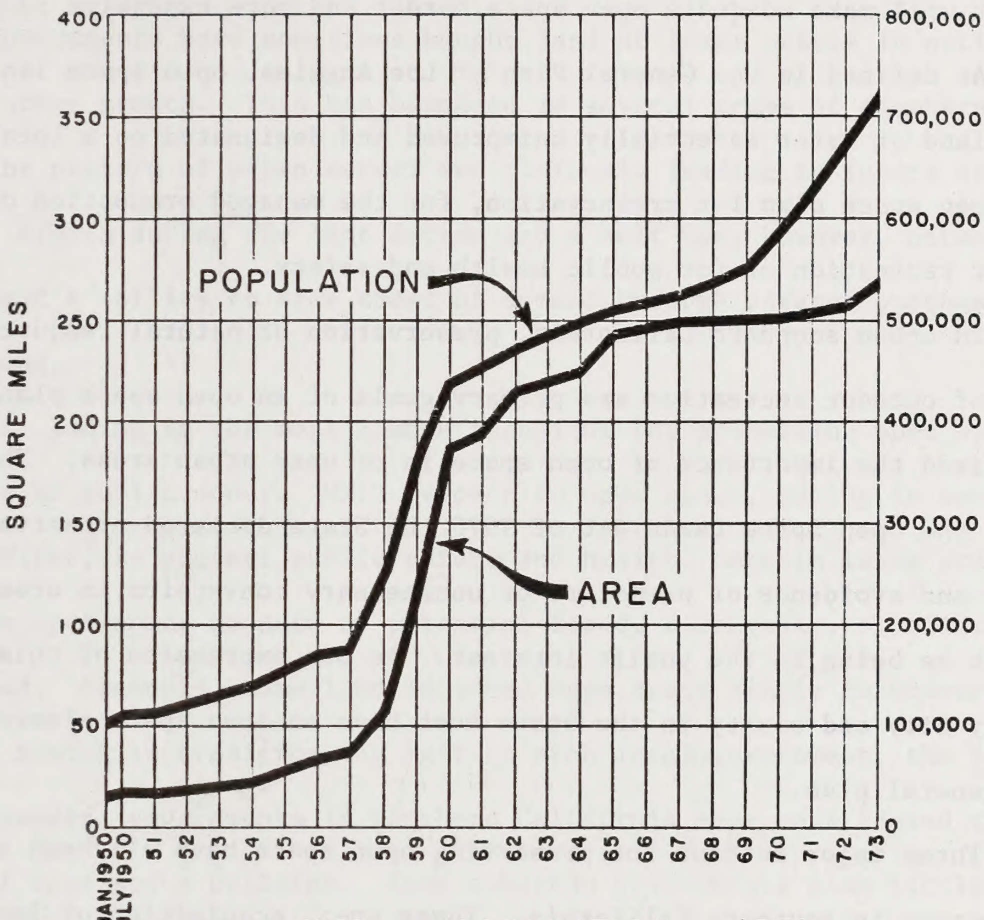
APS service area includes part of Arizona's largest metropolitan area (Phoenix). Tucson is the second largest city in Arizona but is not served by this utility. Next to Phoenix, the two largest communities in Arizona served by utilities participating in the Kaiparowits project are Yuma and Flagstaff. Yuma's population increased 21 percent in one decade; from 23,974 in 1960 to 29,007 in 1970. It is rapidly becoming a city in which agricultural enterprises are being replaced by industrial concerns. Flagstaff is a hub of trade and economic activity in the pine forested area of north-central Arizona. Lumbering, tourism, retail and wholesale trade, and education make up its economic base. There has been tremendous growth since 1950. The city's population rose from 18,214 in 1960 to 26,117 in 1970, an increase of 43.4 percent.

Phoenix has a population of more than 743,000, with a total city area of 269 square miles including some large park lands. Its growth is shown in Figure III-84.

Economic factors important to Phoenix include tourism, electronic appliance manufacturing, government, light industry, retail and wholesale trade, and construction. Phoenix has long offered the business and industrial community of the southwest an attractive tax structure and encouraged a large growth in industry during the past two decades. "Open shop," and "right to work" legislation requiring that no employer in the State restrict employment to union members has helped increase industries attracted to Phoenix. This growth has expanded job opportunities, and per capita income has risen. The unemployment rate in Phoenix (3.7 percent in 1970) has been stable, usually paralleling the national average. Increased urbanization and industrialization of Phoenix has stimulated concurrent growth in nearby smaller cities.

FIGURE III-84

Phoenix Growth



YEAR	POPULATION NO. OF PERSONS	AREA SQUARE MI.
JANUARY 1, 1950	102,548	16.4
JULY 1, 1950	107,116	17.1
JULY 1, 1951	108,158	17.1
JULY 1, 1952	119,000	18.9
JULY 1, 1953	129,956	21.0
JULY 1, 1954	140,062	24.1
JULY 1, 1955	155,788	29.0
JULY 1, 1956	170,082	35.7
JULY 1, 1957	172,569	36.3
JULY 1, 1958	241,899	52.6
JULY 1, 1959	360,771	110.0
JULY 1, 1960	439,671	187.4
JULY 1, 1961	451,964	191.1
JULY 1, 1962	468,385	220.3
JULY 1, 1963	482,521	222.6
JULY 1, 1964	494,061	222.7
JULY 1, 1965	504,448	245.7
JULY 1, 1966	511,238	246.2
JULY 1, 1967	519,006	247.4
JULY 1, 1968	527,774	247.7
JULY 1, 1969	546,381	247.7
JULY 1, 1970	589,374	247.9
JULY 1, 1971	620,750	254.9
JULY 1, 1972	674,000	258.2
JULY 1, 1973	723,700	269.3

Open space in southern California

Open space needs are a deep concern of southern California planners and public officials. Prospects for continued growth and resultant loss of land to development will make adequate open space harder and more expensive to provide.

As defined in the General Plan of Los Angeles, open space land is any parcel of land or water essentially unimproved and designated on a local, regional, or state open space plan for preservation, for the managed production of resources, for outdoor recreation or for public health and safety.

In urban southern California, preservation of natural resources and the provision of outdoor recreation are primary goals of an open space plan. California has recognized the importance of open space in or near urban areas. Through passage of the Open Space Lands Act of 1970 the State declared preservation of open space and avoidance of premature or unnecessary conversion to urban type development as being in the public interest. As one expression of this declaration, every city and county in the State must have an open space element in its required general plan.

Three major methods for preserving open space have all been used to varying degrees in southern California. These are: acquisition of land; zoning to maintain open space; and inducements to keep land in open space.

Outright acquisition of land by a public entity is the most expensive but surest avenue to open space preservation. Through power of eminent domain, government can purchase, at a fair market price, literally any land needed for a valid public purpose. The transfer of land from one governmental entity to another is a further way that local government has acquired open space. This method is of particular importance in counties such as San Diego where large areas are owned by the Federal government for military purposes. Camp Pendelton alone encompasses more than 380 square miles in San Diego County. The Federal

government periodically gives or sells local governments land no longer needed for military purposes.

Because open space land in or near urban areas is usually very expensive, local governments have sometimes bought land at lower prices in anticipation of future urban growth. This has happened in several areas of southern California where the pattern of urban sprawl was obviously leading to future open space needs. Growth during the last decade and a half has, however, often outstripped government's ability to stay ahead of demand through advance purchase of open space land.

Zoning is the most common technique for preserving open space since it involves no public money. With respect to open space, zoning is used in two ways. First, to protect public safety and health, certain lands are usually zoned as open space because of potential flood, earthquake, or slide hazards if developed. Secondly, some land is zoned open space simply to conserve it. Because zoning is traditionally left to each local government, the large number of independent governments in southern California have contributed to a wide array of open space policies. Some suburban governments plan little open space within their boundaries because adjoining cities have facilities used by residents from the entire area. This creates inequities in taxation. The use of zoning for open space also creates intense pressures on the typical city council from land developers. The entire history of southern California sprawl has been written by continuous granting of zoning variances and zoning changes to land developers. The conversion of real or potential open space agricultural lands to urban developments has been commonplace through the area.

The main inducement to open space in California is the taxing of certain privately-held agricultural lands at a rate commensurate with open space designation rather than its greater potential urban value. Through the Land Conservation

Act of 1965 (known as the Williamson Act), local governments may enter into up to 25-year contracts with owners of large amounts of agricultural lands to retain this land's open space character. In return the owner will be taxed at the value of open space and not the potential urban value of the land. Though not addressing the need for recreational opportunities, the Williamson Act has provided an opportunity for local governments to retain large amounts of land as open space. For instance, by 1972 San Diego County had established agricultural preserves, under the Williamson Act, totaling approximately 120,000 acres.

A primary use of open space is for recreational purposes. The Southern California Association of Governments (SCAG) planning documents assume 40 days of outdoor recreation use per person per year. A population growth of 12 million in the next twenty five years would mean about 480,000,000 additional recreation days per year.

This population increase of 20 percent would produce a like 20 percent increase in recreational use. And 12 million more people moving into the region means less land available for recreational open space. Further, the leisure time available to Americans is steadily increasing as the average work week is reduced, meaning the large increase in forecasted demand would be even less than the real need.

There are advantages and disadvantages to a policy of open space preservation. However, the debate over open space policy in southern California revolves around the amount and location of open space, not the need for open space.

Several attempts have been made to develop criteria for local communities to judge adequacy of open space intended for parks and recreation. There is no universally accepted standard, but the following figures show the range of suggested standards of acres per 1,000 people:

Agency Suggesting Standard	Local Open Space (acres/1,000 people)	Regional Open Space (acres/1,000 people)
Association of Bay Area Governments (San Francisco)	15	15
National Parks and Recreation Association	20	40
U.S. Bureau of Outdoor Recreation	5	12
Arizona OUtdoor Recreation Coordinating Commission	7	18

San Diego County uses a criteria of 15 acres of local open space and 15 acres of regional open space per 1,000 people. Los Angeles County has adopted a much more modest criteria -- four acres for local open space and six acres for regional open space per 1,000 people. Local open space includes such facilities as neighborhood parks, pocket parks, school playgrounds, and neighborhood trails. Regional open space includes lakes, beaches, mountain recreational areas and other such facilities within one hour driving time.

Figure III-85 shows acreage in the six county SCAG region now in recreational use. Local recreational land in urban areas is substantially less than called for in the criteria previously presented. The figure also shows very large areas available for recreational use in the regional, coastline, desert, inland water and mountain categories. The vast majority of residents in southern California must commute considerable distances to enjoy these opportunities. This contributes to air pollution. Given present trends, increased growth will increase use of recreation areas and will cause a subsequent increase in automobile trips.

Los Angeles County has the largest population in the main impact area, and it still contains large potential for growth. Several major conclusions can be drawn from the county's official open space plans. Officials have identified

FIGURE III-85

1972 Recreation Resource Areas Inventory

County	Urban Local Recreational Use (acres)	Urban Regional Recreational Use (acres)	Coastline Recreational Use (acres)	Desert Recreational Use (by ownership and acres)	Inland Water Recreational Use (acres)	Mountain Recreational Use (by ownership and acres)
Imperial	178.2	494.1	0	State 34,609 Federal 637,079	288,520	0
Los Angeles	4,490.1	17,927.9	1,569	County 1,547 State 2,875 Federal 2,500	14,165	County 1,310 State 2,053 Federal 649,045
Orange	2,310.2	2,423.0	953	Federal 1	1,002	Federal 51,813
Riverside	1,234.5	5,173.3	0	County 21,225 Federal 2,225,125	61,778	County 349 State 1,351 Federal 258,284
San Bernardino	1,344.5	5,930.0	0	County 630 Federal 6,977,628	9,413	County 102 State 9,415 Federal 427,035
Ventura	647.3	3,700.7	654	Federal 1,000	8,878	State 6,554 Federal 2,085
Total Region	10,204.8	35,649.0	3,176	approx. 9,904,219	383,756	Approx. 1,409,396

Source: Southern California Association of Governments

a current deficiency of 3,450 acres of local parks within urban areas of the county. Further growth would add to this deficiency.

The county has developed a priority list of areas that should become parks or other recreational areas. Some progress has been made toward implementation of this list but all currently identified needs will not be met in the near future.

The most acute need for recreation and open space is in older urban areas, primarily within the City of Los Angeles. These areas tend to be populated by racial and ethnic minority groups. There is potential for serious controversy over open space policy as urban expansion continues.

More than one-half the land in San Diego County (2,685 square miles) is in public ownership and most is undeveloped. However, this land is generally for military purposes or it is mountain or desert far removed from the urban population in the western or coastal section of the county. There is need for more open space near, or at least easily accessible to urban centers. San Diego probably has sufficient park land, but it is not evenly distributed in the urbanized or soon-to-be-urbanized areas. Figures III-86 and III-87 highlight deficiencies in local recreational open space while pointing out the abundance of regional open space according to standards of the San Diego Comprehensive Planning Organization. This group, representing the county and most cities in the county, have called for open space preservation of 3,637 square miles of the county's total 4,255 square miles. Almost 75 percent of this 3,637 square miles is already in public ownership but not easily accessible to some segments of the population.

Lack of open space is directly related to continued urban growth. Utility companies have a responsibility to meet growing demands, but in meeting that responsibility, urban growth is facilitated, giving rise to other problems. One of the most obvious of these is open space deterioration.

FIGURE III-86

San Diego County Local Recreational Open Space Lands Deficiency for Each City and the Unincorporated Area

City	Existing Acres	Deficiency 1970 Acres	Deficiency 1980 Acres	Deficiency 1990 Acres
Carlsbad	15.9	-208	-269	-404
Chula Vista	119.0	-900	-1,069	-1,351
Coronado	22.6	-291	-307	-322
Del Mar	-	-60	-75	-105
El Cajon	34.0	-751	-896	-1,075
Escondido	127.4	-425	-593	-773
Imperial Beach	7.7	-295	-337	-412
La Mesa	63.5	-524	-641	-806
National City	114.5	-533	-545	-575
Oceanside	180.6	-427	-629	-824
San Diego	1,546.5	-8,905	-9,583	-10,888
San Marcos	33.0	-26	-42	-72
Vista	47.4	-324	-433	-553
Unincorporated	402.0	-3,987	-4,938	-6,873
County Total	2,714.1	-17,686	-20,386	-25,036

FIGURE III-87

San Diego County Regional Recreational Open Space Lands Surplus or Deficiency by Major Statistical Area

Major statistical area	Existing Acres	Surplus or Deficiency 1970 Acres	Surplus or Deficiency 1980 Acres	Surplus or Deficiency 1990 Acres
Central	1,863	-5,472	-5,832	-6,252
North City	9,133	+4,873	+3,868	+2,143
South Suburban	4,005	+2,055	+1,815	+1,350
East Suburban	5,272	+2,017	+1,657	+1,147
North County	6,562	+3,082	+2,347	+ 862
East County	1,009,072	+1,008,952	+1,008,922	+1,008,877
County Total	1,035,907	+1,015,507	+1,012,807	+1,008,157

Source: San Diego Comprehensive Planning Organization, 1973

Pollution in southern California

Urban growth is primarily responsible for southern California's environmental problems. The desirable natural characteristics that have attracted people to this area have been jeopardized by urban growth. The mild and sunny climate is affected by smog that irritates the eyes and lungs, suburban development that dominates much of the landscape, and nearby undeveloped areas that are often densely occupied by urban dwellers seeking weekend recreation.

Unplanned and unchecked urban growth has put pressure on southern California's environment, resulting in congestion as well as aesthetic, noise, water, and air pollution. Many miles of streets traverse a maze of hamburger stands, gas stations, neon signs, and billboards. Because excessive urban growth has become urban sprawl, aesthetic pollution has become especially typical of southern California. Sprawl has consumed more and more open space, destroying much of the natural environment that formerly provided visual relief from urban blight. Increased urban growth has added to noise pollution. Motor vehicle exhaust systems and tires, operation of industrial equipment, and inadequate building insulation have all contributed to noise levels causing human stress and sometimes even hearing loss. Perhaps the most burdensome form of noise pollution is from airplanes. Despite technological advances in noise abatement, as urban growth generates more demand for air transportation, noise levels around airports are multiplied. For example, the number of people in San Diego County subjected to excessive noise levels around airports is expected to increase by almost 80,000 by 1995, despite the advent of new, quieter aircraft engines.

But air pollution is even more obvious than aesthetic, noise, and water pollution in southern California. Automobiles are the single greatest source of air pollution. Automobile emissions are responsible for more than seventy percent of the smog in the South Coast Air Basin that includes Los Angeles. In Los Angeles County alone, motor vehicles emit 12,000 tons of pollutants into the air

every day. In 1970 there were thirteen million gas-powered vehicles in California, about half of them registered in the South Coast Air Basin. By 1980, there will be an estimated sixteen million additional gas-powered vehicles in the State.

California has been unable to cope with air pollution produced by vehicles. In 1970, 25 years after California enacted its first air pollution control law, Los Angeles County still was unable to meet the National Air Quality Standard for photochemical oxidants on 65 percent of the days, for carbon monoxide on 55 percent of the days, and for nitrogen dioxide on 31 percent of the days. Most of these pollutants can be traced to automobiles, and to a slightly lesser extent, combustion of fossil fuels in electric power plants. Nitrogen dioxide is the brownish-yellow gas largely responsible for color of the air over regions subjected to photochemical smog. Carbon monoxide produced from incomplete combustion of carbonaceous substances also comes primarily from automobiles.

Figure III-88 shows the five worst pollutants in the Los Angeles Air Quality Control Region and maximum amounts of their concentrations in 1970. Photochemical oxidants were the most excessive concentration. Illustration III-17 shows the number of days that National Air Quality Standards were violated at each of the monitoring stations in the Los Angeles Air Quality Control Region. As might be expected, coastal areas experienced fewer days of excessive concentrations than did areas along the base of the San Gabriel Mountains and in the more heavily populated inland valleys.

Though smog is still a dominant presence in southern California, it has been reduced. The concentration of photochemical oxidant in Los Angeles County peaked in 1966 and has been declining ever since. Figure III-89 shows oxidant trends in the South Coast Air Basin, 1963 to 1972.

Projections of future air pollution levels in southern California are in dispute. The current downward trend in levels brought about by automobile emission controls can be expected to continue at least through this decade as an

FIGURE III-88

An Overview of Air Pollution in the Los Angeles
Air Quality Control Region

Pollutant	National Air Quality Standard[a] Concentration	Averaging Time	Maximum Observed in 1970 Concentration	% of Standard
Photochemical Oxidant[b]	0.08 ppm	1 hour	0.62 ppm	780
Carbon Monoxide	9 ppm	8 hours	41 ppm	460
	35 ppm	1 hour	54 ppm	150
Nitrogen Dioxide	0.05 ppm	annual average	0.09 ppm	180
Sulfur Dioxide	0.03 ppm	annual average	0.03 ppm	100
	0.14 ppm	24 hours	0.09 ppm	64
Particulate Matter	75 $\mu g/m^3$	AGM	100 $\mu g/m^3$	130
	260 $\mu g/m^3$	24 hours	399 $\mu g/m^3$	150

[a] National primary standard shown for each pollutant. The primary standard is intended to protect the public health; secondary standards are long-range goals intended to protect the public welfare (e.g., present damage to vegetation). For photochemical oxidant, these standards are identical.

[b] Photochemical oxidant here denotes a complex mixture of oxidizing substances that are physiologically harmful to humans and plants and are aesthetically objectionable. The National Air Quality Standard for oxidant was set by EPA and is designed to protect all segments of the population from any of the adverse health effects associated with oxidant pollution of the air.

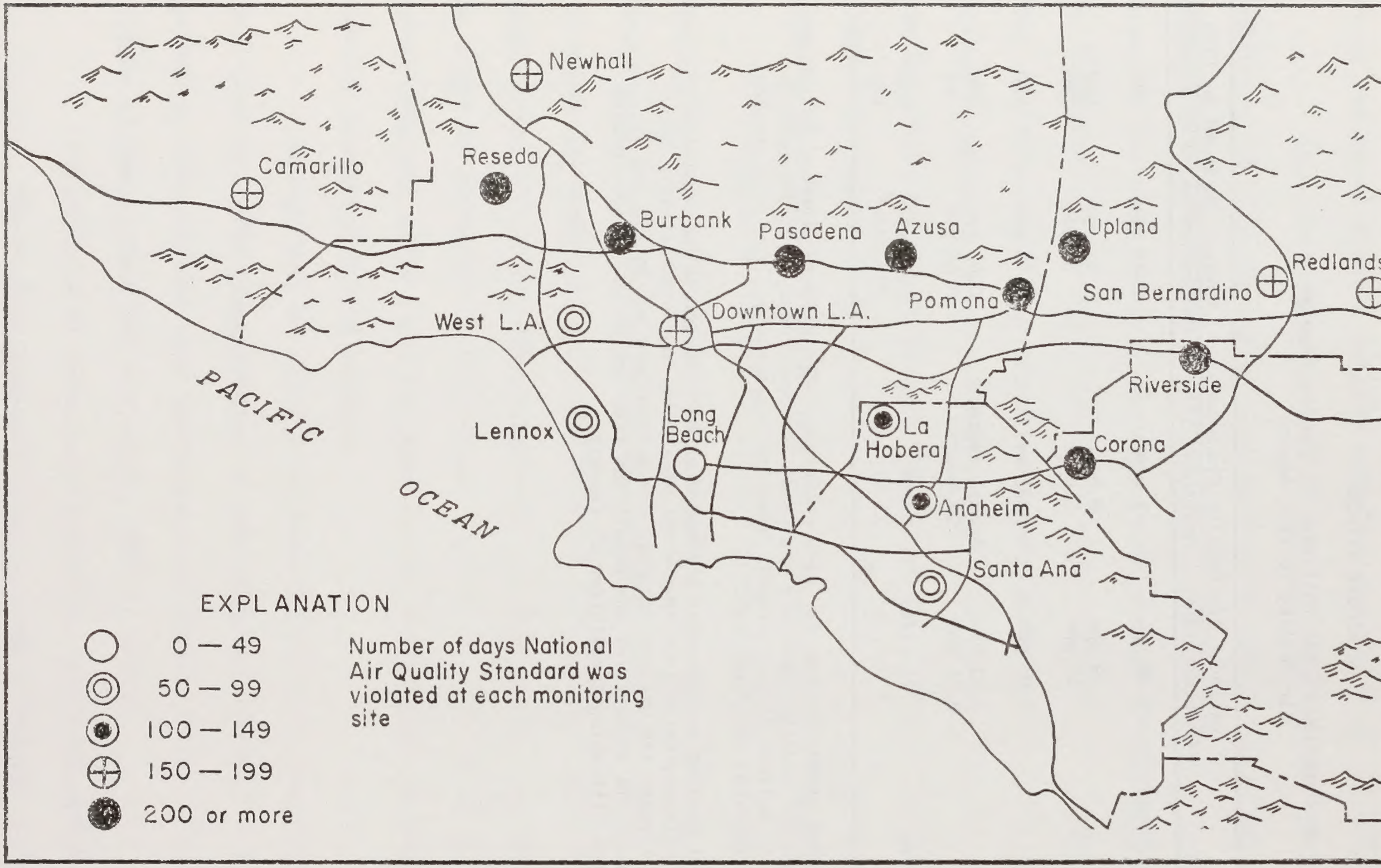


ILLUSTRATION III-17

Spatial Distribution of Air Pollution
in Los Angeles Air Quality Control Region (1970)

FIGURE III-39

Oxidant Trends in the South Coast Air Basin, 1963-1972
(Three-Month Averages of Daily Maximum One-Hour Oxidant Concentrations for July, August and September)

	Oxidant Trend (pphm)									
Station	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972
Anaheim	11.4	9.6	15.9	14.1	12.5	11.9	13.7	10.7	8.9	8.7
Azusa	19.8	24.2	24.4	25.8	26.8	21.9	28.0	28.8	22.9	18.1
Burbank	15.1	15.6	20.9	17.0	22.5	19.0	19.4	18.5	16.1	13.2
Corona	16.4	25.6	16.7	13.8	22.1	16.2	22.0	20.8	13.4	--
La Habra	--	--	15.6	13.3	9.8	11.0	17.2	10.0	15.2	13.3
Lennox	--	--	7.0	7.0	6.7	6.9	6.8	6.2	5.7	3.4
Long Beach	4.2	7.3	6.8	7.8	5.9	4.6	6.3	6.0	6.2	4.0
Los Angeles, Downtown	16.2	15.7	16.2	17.3	13.9	14.3	13.0	13.2	10.0	11.4
Pasadena	20.0	21.9	21.6	22.2	22.6	22.3	27.4	25.7	20.6	17.1
Pomona	--	--	20.8	21.4	23.9	20.8	24.5	23.5	16.6	14.6
Redlands	--	--	--	--	--	17.2	20.4	20.1	17.1	13.8
Reseda	--	--	18.6	19.6	20.9	18.0	20.1	17.4	14.2	12.1
Riverside	17.4	21.2	16.6	18.6	25.2	19.5	25.6	25.6	22.9	22.2
San Bernardino	15.5	12.2	17.0	17.0	18.2	15.2	18.9	23.1	18.7	14.8
West Los Angeles	11.9	10.3	11.3	11.6	11.1	11.2	11.0	10.1	8.4	7.1

NOTE: Blank spaces indicate stations were not operating.

SOURCE: "Oxidant Trends in the South Coast Air Basin, 1963-1972," California Air Resources Board.

increasingly higher percentage of automobiles are equipped with such devices. State officials had even predicted that present emission control programs will meet existing state air quality standards by 1990. However, other experts have predicted that the air will start to deteriorate again by 1982 from new sources of emissions. This prediction assumes that more vehicles, plants, and pollution-making affluence will offset improvements in emission control devices. A different projection comes from a third group of experts who predict a continued, but not substantial decrease in air pollution through 1990. By the late 1980s, when benefits of stringent federal emission standards will be substantially realized, these experts contend the oxidant standard will be violated on as many as 135 days per year at the worst point in the region. Indeed, some experts argue that standards cannot be met in the Los Angeles Air Quality Control Region even with major reduction in vehicle miles travelled, because of emissions from additional automobiles, trucks, aircraft, and stationary sources.

From these different predictions emerges one clear point; the South Coast Air Basin will be subjected to continuing smog. The greater the amount of population growth, and the more it contributes to automobile-dependent sprawl, the worse the air pollution.

Transportation in southern California

The history of transportation in the market impact area has paralleled the history of the automobile. Motor vehicles have served as the primary means for moving people and goods throughout this region. The primacy of the motor vehicle is illustrated in Figure III-90.

FIGURE III-90

Motor Vehicle Registration

County	1961	1973	% Increase
Los Angeles	3,404,147	4,918,510	45
Orange	419,552	1,220,697	191
Ventura	112,447	300,132	167
Riverside	180,977	401,864	122
San Bernardino	281,529	522,777	86
San Diego	520,983	1,604,461	208
	4,191,635	8,968,441	82

According to the California Department of Motor Vehicles, a more subdued rate of increase in motor vehicle registrations can be expected -- around 4.5 percent per annum -- but will nevertheless be greater than that predicted for population. Problems associated with reliance on motor vehicles for transportation are most critical in southern California; 73 percent of all vehicles registered in the State are located in this six county market impact area.

To accommodate its vast number of motor vehicles, California has developed an extensive system of freeways, roads, and streets. There are more than 1,000 miles of freeways within the market impact area. Future freeway construction is expected to at least double, perhaps triple, this mileage. Figure III-91 shows

FIGURE III-91

Existing and Planned Freeway Construction

County	Freeways and Expressways in Operation (mi)	Total Planned System (mi)
Los Angeles	414.5	1,042.1
Orange	127.7	247.6
Ventura	77.3	253.9
Riverside	188.2	392.0
San Bernardino	386.8	971.0
San Diego	195.0	300.0
Total	1,371.5	3,206.6

freeway construction in the market impact area. Motor vehicles are expected to continue providing the major mode of transportation.

Reliance on motor vehicle transportation has meant hardships for many segments of society, particularly the poor, handicapped and elderly who, for various reasons, do not have access to an automobile. As the automobile industry has grown, public transportation has declined throughout the country. In some areas, public transportation facilities are being rebuilt and are expected to supply more of the future transportation needs, but voters in southern California recently defeated a mass transit proposal and mass transit is expected to be far less adequate in southern California than elsewhere.

The Southern California Rapid Transit District (SCRTD) has developed an extensive mass transit plan for the greater Los Angeles area. According to the proposal, mass transit would take two forms: a short-term expansion of existing transit services and longer-range construction of a fixed guideway system similar to that in the San Francisco Bay Area. The major components of the short-term expansion plan include increasing the number of transit vehicles from 1,700 to 2,700 by 1977; construction of park and ride facilities; provision of new express-on-freeway services to serve park and ride passengers; development of new bus-only lanes on freeways; and limited commuter rail service.

Under the SCRTD proposal, passengers would drive to centrally-located terminals and ride a bus to work. By attracting commuters in outlying areas, some reduction in air pollution and freeway congestion could be achieved. In addition, reducing the number of automobiles in the downtown business district would also reduce need for construction of parking facilities. At the present time, 30 percent of downtown Los Angeles is devoted to parking lots. This is in addition to the 30 percent used for streets.

The SCRTD proposal would probably lead to reduction of total energy consumption. According to SCRTD, energy consumption is at least six times greater

greater with automobiles than it is with mass transit. If the SCRTD development reduced cars on the road by their estimated 500,000 vehicles, the energy saved would cover the movement of approximately 4,500,000 people by rapid transit; or four times the anticipated daily patronage.

While rapid transit would bring about a total reduction in energy devoted to transportation, subways and other systems would increase the amount of electricity used. This increase, however, would amount to only 2.5 percent of total electricity sales by Southern California Edison. And this increase should be more than offset by the added fuel available to electric utilities from reduced automobile petroleum consumption.

There is only one major airport in the six county impact area -- Los Angeles International (LAX). There are a number of intermediate airports such as Long Beach, Burbank, and Ontario that primarily service intra-state flights. During the past few years, a number of study groups have recommended construction of an additional international airport at Palmdale in northeast Los Angeles County. Final approval of this facility is uncertain but SCRTD has incorporated a fixed guideway line to Palmdale in its long-range planning.

Mass rapid transit in San Diego has progressed only to the initial study and alternative planning stages. Like Los Angeles, buses constitute San Diego's public mass transit system. A number of alternatives have been proposed -- a heavy rail system, a light rail system, and a fixed guideway system. None of these proposals has been officially approved.

Projections of housing patterns in the San Diego area indicate people will move farther away from their work as "suburbanization" extends in the north county area. Workers will be traveling longer distances to work and spending more time in transit than ever before. This growth away from downtown would require that any planned mass transit system service a large area.

Estimates show that a rapid transit system would attract about 800,000 passengers annually, capturing around 10 percent of all trips made in the San Diego region. With respect to home-to-work trips, the rapid transit system would provide service for about 16 percent for outlying areas and around 50 percent destined for downtown areas.

The future of rapid transit in southern California is tenuous. Meanwhile dependence on the automobile is greater than in any other metropolitan area of the U.S. It appears that this dependence will continue to expand.

Effect on Arizona

The power that Arizona Public Services will receive from Kaiparowits does not represent a large portion of their total supply. Figure III-82 shows that only 14 percent of their total peak demand will come from Kaiparowits. However, acquiring power as needed does facilitate urban growth and Arizona population centers also experience problems generally associated with urbanization.

Prior to 1950, the Phoenix economy was based on agriculture. Stockyards, grain fields, and citrus groves covered the land immediately surrounding the city. At that time, the Phoenix metropolitan area cities were separated by fields, and an urban resident could find ample open space for recreation within a few minutes' drive.

Urbanization of the area reduced the land available for recreational use. During the 1950's, as the metropolitan population increased by 311 percent, there was a decline in agricultural activity and a subsequent filling of open land in and around the central city.

Responding to the decline in open space, parks and recreation sites were established by local governments. In 1956, Phoenix had 35 such park areas. There are approximately 133 municipal park facilities in the city today. More are planned, including the so-called "greenbelt", an open space area covered by natural desert vegetation stretching east to west through the greater Phoenix area. Neighborhood parks are established when new housing tracts are constructed, but maintenance is sometimes a problem.

Residents of the city have seen housing developments heavily encroach upon once scenic landmarks such as Camelback Mountain and Squaw Peak north of the main urban area. This construction has become highly controversial. As a result, a moratorium on some kinds of land development has been declared. Residents and political leaders are becoming aware of the growing need to preserve land in local mountain areas for parks and open space that all can enjoy.

New factories, new businesses, and thousands of motor vehicles brought an increase in air pollutants to the metropolitan area. In 1951, there were 152,121 motor vehicles registered in Maricopa County; by 1970, 726,709 vehicles were registered. The increase of air travel in the Phoenix area, the decrease in bus travel within the metropolitan area and the attendant rise in vehicular travel all added to the rise in pollution of the surrounding environment. Airline exhaust accounts for the second highest source of transportation-related pollution in the Phoenix metropolitan area.

The Maricopa County Department of Health Services, Bureau of Air Pollution Control, was created by statute in 1954 as part of a continuing effort to control air pollution. In FY 1950, 91.3 million gallons of motor fuel were consumed in Maricopa County. By 1970, consumption had risen to 279.9 million gallons. Approximately 75 to 80 percent was used in the Phoenix Metropolitan Area, causing a concentration of air pollution there.

The Bureau of Air Pollution found that maximum levels of gaseous pollutants are reached in November through February when air stagnation conditions are most prevalent. Figure III-92 shows trends for concentration of gaseous pollutants from 1967 to 1973. Air quality figures for suburban cities around Phoenix would reflect lower levels of gaseous pollutants because of their location away from the heavily-industrialized inner city.

Increased tourism, the building of adult retirement communities around the city, increasing freeway development, multiplication of electronics manufacturing plants, and expanded air travel will increase problems of environmental pollution in Phoenix.

Concurrent with deterioration in air quality has been the problem of water supplies and sewage treatment facilities. The Central Arizona Project is constantly striving to meet water demands of Phoenix area residents, and to date the project has been most successful. Sewage treatment facilities have also been expanded to meet increasing needs.

FIGURE III-92

Gaseous Pollutants - Phoenix, Arizona

	Annual Concentration Averages ($\mu g/m^3$)						
Pollutant	1973	1972	1971	1970	1969	1968	1967
Sulfur Dioxide	8.9	9.0	11.9	13.5	16.5	9.9	--
Carbon Monoxide	3,025	4,157	3,892	4,730	5,808	7,306	8,128
Nitrogen Dioxide	70.1	80.5	59.1	53.8	43.9	67.4	73.8
Oxidants	45.4	33.9	31.9	26.9	41.2	53.6	63.9
Total Hydro-Carbons	967.0	1,065.0	1,178.0	1,113.0	1,390.0	1,515.0	1,600.0
Suspended Particulates	157.7	159.3	168.7	176.8	120.5	144.0	--

Source: Maricopa County Department of Health Services, Bureau of Air Pollution Control.
Pollutants were measured at 1845 E. Roosevelt, Phoenix, Arizona.

Since Phoenix and western Arizona are in a desert region, there are few natural or man-made bodies of water to be affected by pollution. Those that do exist, such as the system of reservoirs northeast of Phoenix, are used for recreational purposes as well as for human consumption, irrigation, and industry in the metropolitan area. After being treated in area sewage plants, waste water is discharged into the dry Salt River so no effluent mixes with nearby fresh water supplies. Much of the water for western Arizona comes from the Colorado River or from deep water wells near towns and cities. These sources have remained nearly free of man-caused pollution.

Noise pollution is another consequence of urbanization around Phoenix. Prior to 1950 noise levels were negligible. Concern about noise pollution resulted in several studies during the early 1970's. Noise monitors indicated freeway, airport, and major street intersections were problem areas. Attempts to decrease noise levels through installation of various devices at the airport and on freeways have been made. The effectiveness of these is under investigation.

Downtown Phoenix has had public transportation services since 1887, but residential preferences for private cars, service cuts and fare increases have produced a decline in public transportation patronage (Figure III-93). Traffic congestion, inadequate parking facilities, and air pollution problems have generated discussion and studies, but no major decisions have been made. Continental Trailways and Greyhound Bus Lines serve the area with intra and interstate transportation as well as offering intra-metropolitan service to Phoenix area residents, but they do not compete with the automobile as a preferred mode of travel.

Because of the tremendous rate of growth, Phoenix and its surrounding cities have shared a number of problems: pollution; lack of open space for recreation; and poor transportation. Work has been continuous from the late

FIGURE III-93

Yearly Bus Transit Patronage
(Phoenix Transit Corporation and Predecessor Companies)

Year	Revenue Passengers[a]
1960	9,309,573
1961	8,785,691
1962	[b]6,415,263
1963	7,813,739
1964	7,366,656
1965	6,917,424
1966	7,419,175
1967	5,180,372
1968	5,131,331
1969	4,437,837
1970	4,091,581

[a] Includes passengers carried on charter services.

[b] There was a 56-day strike.

Source: Phoenix Urban Area Public Transportation Study, DeLeuw, Cather and Company, 1972.

1950's on most of these problems. Some successes have occurred, but some failure has slowed down ultimate solutions.

The 1973 Environmental Planning Act is Arizona's most recent legislation dealing with role of the state government in land use planning.

The land use planning program is expected to "result in the preparation of a statewide land use plan" that will include: collection and analysis of social, economical, and environmental data related to present and future uses of land; formulation of alternative goals and objectives; and the description of alternative policies and procedures for development.

To accomplish its stated purpose, the Legislature created an Environmental Planning Commission consisting of nine members appointed by the Governor and three from each house of the Legislature. Legislative history and expiration of the Act on June 30, 1975, suggest the Commission is a temporary body created to study possible methods of establishing a state land planning process on a more permanent basis. The Commission is assisted in its work by the professional staffs of existing state agencies.

Within the Phoenix area aesthetics vary greatly. In some locales attention is given to conservation of indigenous vegetation, control of outside advertising, and architectural design standards. In others, standards are non-existent. The sharp distinction in quality of different neighborhoods increases pollution and transportation problems because it encourages greater suburbanization. Those who work in Phoenix may have to commute long distances to find qulaity areas in which to live.

The Phoenix area is experiencing a pattern of growth similar to Los Angeles. Buildup in the central city area is accompanied by urban sprawl and suburbanization with high reliance on automobiles. Lack of an aggressive mass transportation policy encourages even greater dependence on automobile transportation, this could help to determine the nature of land-use.

Yuma and Flagstaff are not yet major urban centers, but they are experiencing problems that accompany growth. There is a general deterioration of the environment in and around the communities. Flagstaff, located in a pine forest, has a unique opportunity to use the indigenous vegetation to enhance community aesthetics. However, the city is following the old pattern of clearing complete areas of the forest for commercial development.

Several desirable services, such as mass transportation, are inadequate or lacking in the utility service area outside of Phoenix. However, except for the Phoenix area, pollution problems are not presently widespread.

Conclusions

Southern California has been undergoing problems of urban growth and sprawl for decades, whereas problems arising in Arizona are relatively recent and confined to the Phoenix area. Therefore, this report has focused on southern California. Problems in the Phoenix area can be anticipated by examining southern California's experience since similar patterns of dependence on the automobile and suburban development are taking place.

Chapter I describes the class of customer that is projected for the participants' service areas. But, the fact is that the supply of electrical energy has not been demonstrated to actually cause urban growth. (The Science and Public Policy Program, 1975; Final Environmental Impact Statement, Proposed Federal Coal Leasing Program, 1975; U.S. Energy Outlook, 1972; Smith, 1969.)

The only reasonably supportable impact is that adequate energy supplies would facilitate urban growth in the market area. That is, energy supplies would allow growth to continue.

Kaiparowits would only provide a portion of the total supply of electricity. It is only in combination with the total supply that it can be said to have an impact.

Finally, the growth that would be facilitated by Kaiparowits electricity would probably cause a degradation of the quality of life in the market area.

KAIPAROWITS

ENVIRONMENTAL IMPACT STATEMENT

CHAPTER IV

MITIGATING MEASURES

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MITIGATING MEASURES

SUMMARY

If the proposed project is approved, federal, state, and local government agencies having jurisdiction in the Kaiparowits Plateau impact area would issue rights-of-way and other grants to allow implementation of those portions of the proposed project on lands under their respective administration. These governmental entities are obligated under statutes, regulations, and specific contractual requirements to specify stipulations intended to reduce environmental impacts. These are administrative measures that would specify certain physical actions for compliance. Federal agencies would have little authority on private land, such as the generating station and town site.

The water service contract states that air pollution control designs and specifications would require the Secretary of the Interior's written approval in advance of construction, installation, or major modifications. The contract require that air pollution control equipment must be designed for 99.5 percent removal of particulates and would be operated to remove not less than 97 percent of particulate matter from stack emissions in each month and not less than 96 percent in any 24-hour period. However, Environmental Protection Agency standards which are more restrictive, would have to be met. For average grade coal at maximum load, they would permit the release of not more than 35.5 tons of particulates, 427.2 tons of sulfur dioxide, and 249.6 tons of nitrogen oxides per day. Operation of the air pollution control equipment would be verified by monitoring equipment, and records thereof subject to inspection by the Secretary or his agent.

The Lake Powell water service contract requires submittal of plans for waste water, waste materials, and sewage disposal facilities to the Secretary for approval in advance of construction, installation or major modifications. Steps must be taken to reduce the risk of harming fish and wildlife, and water quality and quantity must be monitored.

Requirements relating to preserving the quality of interstate water are outlined in the Federal Water Pollution Control Act, as amended. The Fish and Wildlife Coordination Act, as amended, requires consultation with the U.S. Fish and Wildlife Service before water is removed from a body of water under federal permit.

Stipulations intended to reduce impacts would accompany authorizations for rights-of-way and the mining of coal and aggregate. Coal mining would have to include measures to reduce subsidence. Federal land management agencies must also require that archaeological, historical, and paleontological values be protected. Vehicle use, camping, and collection of wood products, mineral materials, and petrified wood are also regulated on public lands, which would reduce some impacts resulting from activities of an increased population.

Utah has statutes and regulations relating to air quality, water, rights-of-way over state lands, wildlife, and occupational and coal mine safety.

State and local government agencies have authority to take actions to mitigate social impacts. Examples are passage and enforcement of land use planning and control laws. Most of these actions are optional. The participants have proposed a contingency housing plan, and the State of Utah has passed legislation and created an advisory council that could implement measures to reduce the social and economic impacts of poorly planned and hastily provided housing services.

The participants propose certain measures which exceed legal requirements to mitigate environmental impacts. These are described in detail in Chapter I. These proposed measures include installation of precipitators and scrubbers designed to remove 99.5 percent of particulates and 90 percent of sulfur dioxide from stack emissions, disposal of all waste water and solid waste on site, and implementing a contingency housing development should the new town not be developed when needed. It is assumed the participants would act in good faith in carrying out the mitigation actions to which they have committed themselves in writing.

If they do not, or should the measures fail, impacts would occur as described in Chapter III. If the measures are successful, impacts would occur as described in Chapter V. Many of the proposed measures are general, and cannot be fully analyzed as to their specific mitigating effects.

If carried out as proposed, the overall immediate effects of the participants' proposed mitigating measures in the Kaiparowits Plateau impact area would be to reduce emissions of particulate matter to 10.3 tons per day and sulfur dioxide to 276 tons per day, using average grade coal. The participants would rehabilitate a total of 2,140 acres and reclaim 1,245 acres after project abandonment. Runoff and sediment loss would be reduced slightly by mitigating measures. The reduction in runoff would be 8.2 acre-feet and 0.41 acre-foot in sediment loss annually.

Rights-of-way, Indian and private land would be subject to separate negotiations with the individual land owners. Rights-of-way across federal and state lands would include stipulations determined by the appropriate agency.

Transmission system construction activities producing high noise levels on national resource lands would be located at least 1/2 mile from residential areas. This would insulate residents from high volume noise activities. Preventative measures for dust control during construction and operation would be required to prevent deterioration of existing air quality.

Effects of the proposed action on the environment in the transmission system impact area would be lessened if all proposed mitigating measures for soils resources were implemented. These measures would reduce sediment yield, reduce the time frame for reestablishment of ground cover and reduce wind and water erosion. Ground cover in areas of medium to high rehabilitation potential would reestablish in 1 to 3 years under normal climatic conditions.

If all measures proposed for mitigating vegetative impacts in the transmission system impact area were implemented, considerable recovery, through rehabilitation, would occur. This assumes returning all temporarily disturbed

areas to a near natural state of production. Some areas could become more productive than they are under current (predisturbance) conditions. Rehabilitation of the generating plant site may be less effective because of greater disturbance.

Mitigating measures would minimize impacts on many wildlife species and their habitats near the proposed transmission system. The endangered or threatened wildlife species and their habitats would be protected or disturbance minimized by adjusting the season, area, or method of construction.

Proposed measures for protecting paleontological, archaeological, historical, and cultural values would reduce losses by identification of these values, providing for their avoidance to the greatest possible extent, and salvage operations where unavoidable. All measures reflect requirements of existing statutes, regulations, and a presidential executive order. Specifications in these mandates require such measures for all land, regardless of ownership.

Proposed mitigation measures would reduce visual impacts, protect recreational values, and ensure public access to national resource lands. These measures would also ensure public safety and added conveniences for recreationists.

In the proposed transmission system impact area, proposed mitigating measures would prevent destruction of livestock facilities and minimize disruption of operations. Maintenance measures would improve or prevent degradation of existing road systems.

The participants would be required to keep the granted rights-of-way and improvements located thereon in a safe and repaired condition so that authorized uses of the public lands would not be impaired.

Sewage effluents and toxic material would not be discarded on public lands, but would be disposed of in designated public disposal sites.

In the limestone quarry impact area, the U.S. Forest Service would be the primary authorizing agency. Permits from the Forest Service would include

stipulations to protect air, water, vegetation, wildlife, and cultural values. Prior to issuing a permit, a rehabilitation plan would have to be submitted by the participants for approval.

The National Park Service could require the limestone haulage trucks to move only at night, to reduce traffic hazards.

Mining and rights-of-way on state lands would require permits from the State of Utah. Water rights would have to be obtained from the state, and all Utah regulations pertaining to vehicles, safety, health, sanitation, solid waste disposal, and air and water pollution would have to be observed.

The participants have proposed several mitigating measures. Several of these would reduce aesthetic impacts. They are somewhat more specific than measures proposed by federal agencies at this time, but nevertheless are still quite general. The participants' reclamation plan would rehabilitate 130 acres after abandonment of the project.

INTRODUCTION

This chapter is divided into sections based on the three impact areas. These are the Kaiparowits Plateau, Transmission System, and Limestone Quarry. Each impact area section is then divided into three subsections. These are: Measures Proposed by Federal Agencies; Measures Proposed by State and Local Entities; and Measures to be Implemented by the Participants.

Various authorizations would be required for the participants to implement their proposal. These have been discussed in Chapter I. Some of these authorizations would involve several government agencies. For example, the proposed water intake station at Lake Powell would require permits from the National Park Service and the U. S. Army Corps of Engineers, after consultation with the U. S. Fish and Wildlife Service and the Utah State Division of Wildlife Resources. Rights-of-way for the water pipeline would have to be obtained from the National Park Service, the Bureau of Land Management, and the State of Utah. Similarly, rights-of-way for the transmission system would be required from the National Park Service, Forest Service, Bureau of Land Management, Indian tribal councils, Bureau of Indian Affairs, and State Land Commissions for State Lands. Either easements or fee title transactions would be necessary for the transmission system to cross privately owned lands. The authorizations from government agencies enable these agencies to impose requirements to mitigate environmental impacts.

Bonding requirements of the Forest Service and Bureau of Land Management and penalties that can be imposed are not mitigating measures, but are means of ensuring compliance with stipulations in grants issued. Administrative jurisdiction over grants is vested in authorized officers.

Government entities must comply with several statutes and regulations that pertain to the environment. Several of these are applicable to the

authorizations required by the participants in order to implement the proposal. Among these are specific statutes and regulations, such as the Clean Air Act of 1970, that require federal agencies to take steps where appropriate to prevent degradation of some particular part of the environment.

Other statutes and regulations are general, such as the National Environmental Policy Act of 1969. Federal agencies are also required to comply fully with these laws, but means of compliance are discretionary because the appropriate agency must use judgment in assuring compliance with the intent of the law in specific instances.

Administration varies according to legal authorization. Federal and state entities would have limited authority with respect to operations on state or federal lands that would be transferred to private ownership, such as the plant site and town site. Jurisdiction over private individuals on public land is limited both by authority and by operational capabilities.

Mitigating measures proposed by the participants are described briefly in Chapter I as part of the project proposal. Those measures that differ in some way from what would be required by a government agency are summarized in this chapter as measures to which the participants have committed themselves in writing. They would be implemented by the participants as physical actions, many of which reflect recognition of applicable statutes and regulations, plus stipulations that would likely be imposed by authorized government entities.

The assumption in this chapter is that participants would act in good faith by implementing the measures they have proposed and in complying with applicable statutes and regulations. Should this not be the case, however, or should the measures fail, the results would be described in Chapter III.

If mitigating measures described in this chapter were carried out, reducing the environmental impacts discussed in Chapter III, there would still be the residual, unavoidable impacts set out in Chapter V.

Measures proposed by federal agencies

Several mitigating measures enforceable by federal agencies are applicable to proposals for the generating station, mine, new town, and highway, as appropriate. The agencies that would be particularly concerned are the Bureau of Land Management, National Park Service, U.S. Geological Survey, Bureau of Reclamation, Mine Enforcement Safety Administration, Environmental Protection Agency, and Occupational Safety and Health Administration.

Generating station

The Kaiparowits water service contract with the Bureau of Reclamation provides for furnishing industrial water from Lake Powell to the proposed Kaiparowits power project. Water would be used for thermal-electric generation, including associated coal mining, coal transportation and ash disposal. Municipal use is not mentioned. The contract may be terminated by the United States, upon failure of the contracting entity to perform its obligations, or by the contractor giving the United States a 2-year written notice.

Designs and specifications for air pollution control equipment require written approval from the Secretary of the Interior in advance of construction, installation, or major modification, subject to arbitration in the event of disagreement. Equipment is required to have a specified design efficiency to remove 99.5 percent particulate matter in stack emissions if technology at the time makes it practicable to meet such percentages with a commercially proven design.

The contract specifies that air pollution control equipment must be operated to remove not less than 97 percent particulate matter in the stack emissions in each month and not less than 96 percent in any 24-hour period. At least once every 10 years, representatives of the Secretary of the Interior and

the contractor must review technological advances and decide upon the feasibility of installing additional equipment or modifying existing equipment. Operation of air pollution control equipment must be verified by monitoring equipment, and records must be provided to the Secretary at least annually. In addition, equipment would be subject to inspection by representatives of the Secretary.

Federal agencies are required to act in compliance with the Clean Air Act of 1970, as amended, in authorizing use of public lands. In requiring 97 percent operating capability for removal of particulates, technology permitting, the water service contract is less restrictive than the federal standard of 0.1 pound per 10^6 British thermal units that would require approximately 98.8 percent removal, using worst grade coal, or 98.3 percent using average grade coal.

Therefore, although the water service contract requires a design capability of 97 percent particulate removal, lower operating efficiencies would be allowable, but could not be less than Environmental Protection Agency (EPA) standards. In complying with EPA standards, emissions under 100 percent load would be not more than 35.5 tons of particulate matter per day, regardless of whether average or worst grade coal would be used. Although compliance with these standards would significantly reduce the amount of ash emitted to the atmosphere, it would result in large amounts of residue ash that would require disposal. At 100 percent load, 2,274 tons of fly ash and bottom ash would be collected for disposal each day if average grade coal were used, and 3,078 tons would be collected using worst grade coal.

The water service contract does not specify any control of sulfur dioxide emissions, but it states that the participants would not be relieved from compliance with applicable air pollution control laws and regulations. EPA standards would permit the emission of not more than 427.2 tons of sulfur dioxide per day. State of Utah standards could be more restrictive, however, and would then set the legal limits (see next section of this chapter).

EPA standards for nitrogen dioxide emissions are 249.6 tons per day.

Regulations for Prevention of Significant Air Quality Deterioration became effective January 6, 1975 (see Air Quality section, Chapter III). These regulations call for establishment of "classes" of different allowable incremental increases in total suspended particulates and sulfur dioxide. Ultimate responsibility for assuring successful implementation of these regulations lies with the state. If a state cannot or does not desire to implement the regulations, the EPA would perform or delegate these responsibilities. Increases in emissions of particulates and sulfur dioxide that would be allowable under these regulations could be more restrictive than the EPA new source performance standards, cited above (see Air Quality, Chapter III).

In addition, air quality standards of Occupational Safety and Health Administration (OSHA) and the Mine Enforcement Safety Administration (MESA) also apply to the environment in and around the working areas of the generating station and mine, respectively. Utah has adopted these standards which permit not more than 2.4 milligrams per cubic meter of coal dust with less than 5 percent silica, 5 milligrams of respirable dust, and 15 milligrams of inert dust.

The water service contract specifies that designs and plans for disposing of waste and other residue from burned fuel must be submitted for written approval by the Secretary of the Interior, prior to construction, removal, or modification. Any objections regarding air pollution control or waste disposal, which cannot be resolved by mutual agreement, shall be submitted to arbitration.

The water service contract also requires compliance with applicable federal and state laws, orders and regulations concerning pollution of streams, reservoirs, ground water, or water sources. Also, the contractor must have approval of the Secretary of the Interior for waste water, waste materials, and sewage disposal plans in advance of construction, installation or major modification.

Environmental Protection Agency regulations would not permit the release of heat to drainage waters, except for the amount of heat in cold side blowdown from cooling towers and ponds. The intent is to reduce or eliminate thermal pollution.

Installation of the pumping station intake structure in the navigable waters of Lake Powell would require a permit from the U.S. Army Corps of Engineers under authority of Section 10 of the River and Harbor Act of 1899, as well as a special permit from the National Park Service. The Fish and Wildlife Coordination Act provides legal basis for requiring mitigation of fish and wildlife losses occurring as a direct result or incidental consequence of the use of water from Lake Powell.

Under these authorities, the National Park Service may require that screening devices be used at the intake installation to reduce the possibility of killing or harming fish.

The National Park Service also proposes that microwave facilities on Nipple and Fourmile bench and at the water intake structure would be located or designed so they would not appear on the skyline. All microwave facilities would be a color that blends into the surroundings and have a nonglare surface. In addition, the intermediate pump station at Nipple Bench would be concealed to view from Highway 89 and Lake Powell.

Environmental Protection Agency Guidelines require that runoff from retention basins must not contain more than 50 milligram per liter total suspended solids and must have a pH from 6.0 to 9.0. Exceptions are made for facilities designed to retain runoff from a 10-year, 24-hour rainfall.

Compliance with all these measures would reduce likelihood of contaminating Lake Powell and drainage from the Kaiparowits Plateau, the possibility of loss of fish and other aquatic life, and reduce visual impact of the water supply system.

In addition, water quantity and quality of all springs and seeps in the area that may be affected by waste water disposal, solid waste disposal, or mining would be monitored by the participants by methods and at intervals acceptable in the Department of the Interior. This measure is required under authority of the water service contract and the coal leases. It is necessary to determine the effectiveness of measures proposed to protect water quality.

Effects of increased salinity in the Colorado River that might come from the proposed project could be mitigated by the Colorado River Water Quality Improvement Program implemented under the Colorado River Salinity Control Act of 1974 (P.L. 93-320). Figure IV-1 shows the 1941-72 average dissolved solids concentration of the Colorado River at three stations and the effect of three Upper Colorado River Basin authorized salinity control projects (Paradox Valley, Grand Valley and Crystal Geyser) on river salinity at Lees Ferry, Arizona (data from U.S. Bureau of Reclamation, 1975). Measures that would prevent increased salinity of the Colorado River from the proposed project would have to be determined by the Secretary of the Interior.

Although this is primarily a monitoring procedure, detectable increases in salinity of the Colorado River might be determined as to their source. Should the proposed generating station cause an undesirable increase in salinity, the salinity measurements implemented under the Act would be effective in indicating a need for mitigating steps.

Measures implemented under the Act must comply with the Federal Water Pollution Control Act Amendments of 1972. Guidelines are provided by EPA regulations (40 CFR 120), which set out a salinity control policy, procedures for establishing salinity standards, and a plan for meeting the standards. Colorado River Basin states are adopting the standards and implementation plan.

FIGURE IV-1

Average Dissolved Solids Concentration
Colorado, Green, and San Juan Rivers (1941-72)

River	Concentration (mg/ℓ)[a]							
	1941-72 Historical Average	1972 Modified Condition	Estimated Future Condition[b]					
			1980 Zero TA	1980 2 TA	1990 Zero TA	1990 2 TA	2000 Zero TA	2000 2 TA
Green at Green River, Utah	456	471	486	486	524	536	543	365
Colorado Cisco, Utah	612	659	684	684	741	751	774	797
San Juan Bluff, Utah	447	466	535	583	668	974	677	997
Colorado at Lees Ferry, Arizona	558	607	640	647	711	756	742	801
			622[c]	629[c]	677[c]	722[c]	705[c]	764[c]

[a]Information from U.S. Bureau of Reclamation, "Quality of Water in Colorado River Basin," Progress Report No. 7.

[b]Indicates two assumed conditions of additional salt pickup from new lands, zero and 2 tons per acre.

[c]Includes the effect of three authorized salinity control projects.

The water service contract does not grant rights-of-way, such as for roads, pipelines, or transmission lines. Tramroads for mining, and roads and highways over public lands require authorization from the appropriate federal agency. In the case of roads and highways over public lands, it must be determined whether the use of land or material: (1) is contrary to public interest or the purpose for which land or material has been reserved; (2) is consistent with the agency's management program; and (3) is consistent with Title 23, United States Code (Interstate and Defense Highway System) if applicable.

Other regulations pertain to rights-of-way for pipelines and transmission and communication lines. In the Kaiparowits Plateau impact area, rights-of-way would be granted by the Bureau of Land Management and the National Park Service.

Rights-of-way grants for roads, transmission, communication, and pipe lines would include stipulations which would be applicable to the mining area as well as to rights-of-way for roads and other service lines to the generating station and new town. These stipulations are intended to minimize environmental disturbance, aesthetic impacts, and land and resource use conflicts. They are not specific at this time, and would not become specific as to location or method unless the Secretary of the Interior approves the participants' proposal. Stipulations are, therefore, general and cannot be analyzed as to particular mitigating effects. Following are examples of such stipulations:

1. a. All service power lines would be designed to minimize visual impacts.

b. No unnecessary disturbance or clearing of vegetation or disturbance of the surface would be permitted for aboveground power lines. Necessary exceptions would have to be approved by the authorized officer.

2. Road rights-of-way would be water barred as directed to reduce erosion. Distance between water bars would be based on a drop in elevation of 2 feet. Since decrease in water rate of flow in turn decreases rate of erosion, spacin

based on a 2-foot drop in elevation would provide for dissipation of flow rate before it becomes too high and no longer manageable.

3. Drainage patterns of all channels that would be crossed by roads, highways, and pipe lines would be left in their natural state and not straightened or rerouted. This stipulation would reduce the likelihood of increasing stream gradients that would accelerate the rate of flow and streambed erosion. Channel straightening and rerouting usually increases channel gradient resulting in increased water velocity causing increased streambed erosion and headcutting.

4. Culverts would be placed in the road bed in such a manner that water would flow toward the downstream side so as not to create or accelerate erosion. This could necessitate the use of half-round pipe and a device to dissipate the water flow energy on the downstream end. Water allowed to fall free from the culvert to the soil mantle results in erosion. This energy must be dissipated before the runoff water comes in contact with the soil mantle.

5. Drainage ditches placed alongside highways and access and patrol roads would be placed on the contour and on grade so as to gradually reduce the rate of water flow and deter erosion. Water flowing on the contour and on grade allows for gradual dissipation of energy, which in turn results in very little or decreased erosion.

6. A balanced cut and fill procedure would be used where feasible in all projects requiring grading to reduce erosion and ground disturbance. Water pipe lines should be placed underground except for canyon crossings to reduce visual impact.

7. Roadways should be signed as necessary to warn travelers that livestock are in the area. Cattleguards should be installed on fence crossings. Areas of livestock grazing should be fenced. These measures are intended to reduce traffic safety hazards and minimize the loss of livestock.

8. To help control possible erosion, rock rip-rap should be placed on all disturbed areas that exceed 1.5 percent in slope and that do not have sufficient soil to establish vegetation. If possible, the rock rip-rap should be obtained from underlying rock strata during construction and stockpiled for use in surface rehabilitation. The rock rip-rap should not be less than 2 inches in diameter.

9. The ash and scrubber sludge pile and coarse refuse pile in the mining area would be shaped, compacted, graded, and protected by drainage ditches or bars to reduce contact with runoff water and the likelihood of erosion and landslides from the waste piles. Pools of standing water should not be allowed to collect on the piles. As the piles are abandoned, they should be covered with a soil layer at least 18 inches thick and seeded as approved by appropriate agencies. Several attempts at revegetation may be necessary. These measures would be intended to reduce pollution of drainage and erosion and to encourage development of areas which are environmentally productive. Measures to reduce contamination of drainage are consistent with the water service contract and laws and regulations pertaining to water pollution.

10. Power lines servicing the generating station, mine, and new town must have line spacing and other features to prevent electrocution of large perching birds, such as eagles.

In addition, archaeological and historical values should be identified and protected prior to construction. The Federal Antiquities Act of 1906 provides for protection and preservation of vertebrate fossils of an actual and real historic or scientific interest or of some unusual significance. Federal agencies are required to comply with this Act, and with the National Historic Preservation Act of 1966, National Environmental Policy Act of 1969, Executive Order 11593, and the Historic and Archaeological Data Preservation Act of 1974 in preservation of archaeological and historic values. The agencies must specify

that grantees provide for archaeological and historic surveys of proposed sites and routes, by a professional archaeologist, in advance of any construction activities. Significant archaeological resources would be described and evaluated for their National Register potential.

Additionally, Section 106 of the National Historic Preservation Act of 1966 provides for protection of archaeological and historical resources. Not only does the Act apply to cultural properties on the National Register, but it also extends protection to sites and districts considered of National Register caliber.

When, and if feasible, the Secretary of the Interior may require relocation of proposed facilities to avoid significant paleontological and archaeological resources. As deemed necessary, salvage of cultural and paleontological values may be the only recourse. At the Secretary's discretion, costs of survey and salvage might be borne by the participants.

In areas likely to be disturbed, where surveys have not been completed, intensive studies of paleontological, archaeological, and historical resources would be accomplished. The studies would be carried out by qualified institutions and individuals possessing an antiquities permit, and under a research plan. Parties conducting the studies and developing the research plan would be approved in advance by the Secretary. This measure would assure that all sites evident on the surface are known prior to potential disturbance and protected from inadvertent loss, as required by the statutes.

The Secretary may also require relocation of ancillary facilities to avoid damage to significant paleontological, archaeological, and historical resources. Resurvey would precede relocation and placement of these facilities. Salvage excavation would be used to mitigate loss of these values only when the grantee of permits can fully justify excavation as a last resort, and can demonstrate

that no other measure can preserve the site and its information in the original condition. This would assure that all practicable solutions would be taken to protect and preserve such sites from needless loss, as required by appropriate laws. Grantees would provide qualified professional archaeologists and bear the costs of survey and salvage.

In the event that significant paleontological or archaeological resources are encountered during construction, that phase of construction would be halted until such time as the Secretary has determined that impacts are adequately mitigated, as required by law.

All personnel employed by the participants would receive information on the importance of paleontological, archaeological, and historical resources, and the purpose and necessity to protect these resources. Applicable state and federal law would be stressed, and management personnel would be urged to provide strict sanctions in enforcement of these laws. Vehicles and equipment would be operated only in specified areas which have received prior clearance. Collecting artifacts and fossils or exploration would not be allowed. This measure applies to preconstruction, construction, cleanup, and maintenance operations as required by appropriate laws.

Compliance with these requirements would eliminate or reduce loss and damage to archaeological, paleontological, and historic values resulting from proposed actions. These regulations are applicable to all areas of federal authority.

Several laws and regulations which define the responsibilities of federal agencies would affect the activities of new residents, although they would not be enforceable in the new town itself. Federal land management agencies are required to regulate the gathering of wood products, mineral materials, and petrified wood, the operation of motor vehicles, and camping. Collection of

wood and minerals can be authorized by permits, which limit the amounts that can be collected. Collecting must be done in a manner that minimizes environmental disturbance and waste, and it may be prohibited in specified areas. Vehicle use must be conducted to prevent destruction of land and vegetative resources and with full consideration of public safety and property, and may also be restricted to specific areas. Camping is permitted only in specified places and campers are to observe rules that promote protection of the environment and regard for the safety, health, and convenience of others. Unauthorized removal of materials and use of public lands constitutes trespass and is subject to prosecution. Enforcement of these regulations would reduce environmental impacts resulting from activities of the increased population.

Mine

Mining of mineral resources owned by the United States is subject to supervision by appropriate federal agencies, authorized by specific laws and regulations. In the case of the proposed coal mining, the Bureau of Land Management is responsible for management of surface resources in a manner consistent with its multiple use planning system. The U.S. Geological Survey is responsible for approval or disapproval of the mining plan prior to implementation and for supervision of the mining operations. The Geological Survey consults with the Bureau of Land Management with regard to surface protection and reclamation, and representatives of both agencies must conduct an inspection at termination, expiration, or renewal of the lease to determine whether stipulations have been fulfilled.

Section 5 of the coal leases held by the participants provides for protection of the surface, natural resources and improvements. The lessee agrees to take such reasonable steps as may be needed to prevent operations from unnecessarily: (1) causing or contributing to soil erosion or damaging any

forage and timber growth thereon; (2) polluting waters of springs, streams, wells or reservoirs; (3) damaging crops, including forage, timber, or improvements of a surface owner; or (4) damaging range improvements whether owned by the United States or by its grazing permittees or lessees.

Also, upon partial or total relinquishment, cancellation or expiration of the lease, or prior thereto when required by the lessor to the extent deemed necessary, the lessee would fill excavations, remove or cover all debris, and, so far as reasonably possible, restore the surface of leased land to its former condition, including removal of structures. The lessor may prescribe steps to be taken and restoration to be made with respect to federal lands and improvements thereon.

The Environmental Protection Agency has proposed regulations that would apply to the coal preparation plant and ancillary areas, coal storage, refuse storage, and alkaline mine drainage. As proposed at this time, no discharge to drainage courses would be allowed from the coal preparation facilities. The remaining facilities would be subject to standards, to be promulgated, covering effluent limitations of total and dissolved iron, aluminum, manganese, nickel, zinc, suspended solids, and pH.

For mining of aggregate on national resource lands administered by the Bureau of Land Management, Department of Interior regulations require technical examination by an interdisciplinary team taking into consideration the need for the preservation and protection of other resources, including recreational, scenic, historic, and ecological values; the control of erosion, flooding, and pollution of water; the isolation of toxic materials; the prevention of air pollution; the reclamation by revegetation, replacement of soil, or by other means, of lands affected by the exploration or mining operations; the prevention of slides; the protection of fish and wildlife and their habitat; and the prevention of hazards to public health and safety. The agency in charge on this

interdisciplinary team would be the Bureau of Land Management. Any pumping of water from an aggregate pit for the purpose of drying it out would require a permit from the EPA.

The regulations also require development of general requirements that the applicant must meet for protection of nonmineral resources, and for reclamation of lands or water affected by exploration or mining operations. Although these regulations are general, they must be met by specifications identified by appropriate authorizing agencies with which the applicants must comply. These general regulations for all mining would be the basis for more specific stipulations.

Following are mitigating measures that would be included as stipulations in authorizing grants:

1. The participants would be required to protect areas sensitive to damage from subsidence, including but not limited to canyon bottoms, canyon rims, and cliffs. This would be accomplished by leaving supporting material in place. Where multiple coal beds are to be mined, and the overburden is thin, unmined support pillars would be columnized or aligned vertically.

A substantial portion of the mining area underlies Warm Creek and Missing Canyon drainages. In the southern part of this drainage the interval between the canyon bottom and the coal seams is not great. To attempt to extract pillars under these areas would result in subsidence and breaks in the surface. Normally the canyons do not carry any water, however, during the flash flood season they could carry large volumes of water. Therefore, to prevent flooding, endangering the mining crews and prevent surface disturbance, pillars could not be extracted under these areas. Rimming the canyon walls are vertical sandstone cliffs. Mining of pillars under these rims would result in slides. Therefore, to prevent disturbance of the cliffs, pillars would have to be left in place. Pillar extraction and longwall mining would be confined to areas back from the canyons and canyon walls and under the plateau where subsidence would have a minimal effect. (See Illustration IV-1.)

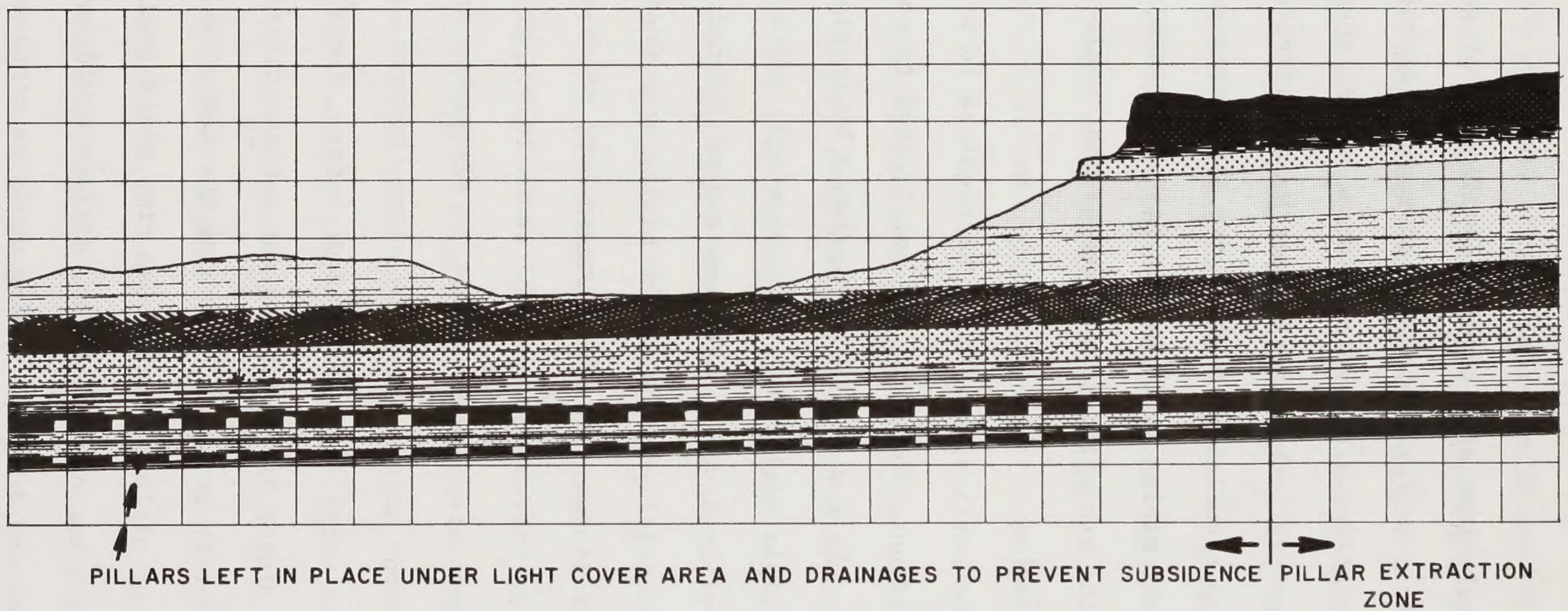

ILLUSTRATION IV-1

Protection Against Subsidence in Sensitive Areas

2. To further minimize surface disturbance in the mining area, a corridor concept would be used where possible for all transportation and communication facilities such as roads, pipe lines, power lines and conveyor systems.

3. Major drainage channels would be left unimpaired by all facilities wherever possible. In no case should routing of storm runoff lead to an increase in runoff volume over that existing prior to construction. This provision should preserve the natural landscape along the drainage ways.

As with other measures that would be proposed by federal entities, the above are general and incomplete. Specific stipulations would be developed should the project be approved, identifying particular measures and locations for application. These would include measures listed as appropriate for rights-of-way and archaeological requirements, and would be developed specifically in accordance with the mining plan to be submitted to the Geological Survey for approval.

New town

No specific administrative mitigating measures would be applicable to the new town. However, should the town developer or local officials wish to obtain additional public land for recreational or public purposes, such as for a sanitary land fill, general requirements under the Recreation and Public Purposes Act would have to be met. These requirements include avoidance of environmental impacts and incompatibility with surrounding existing land use and known land use planning, where feasible. This Act also could be the basis for mitigating overcrowding and its consequences, should the town site eventually prove too small, or to alleviate conflicts, should facilities such as sanitary land fill need to be relocated.

Therefore, no mitigating measures have been proposed at this time. Federal agencies would have no authority in the town site after the land had

been transferred from public ownership. However, stipulations pertaining to rights-of-way for roads, transmission, telephone, and pipe lines, and to land granted for recreation and public purposes, would be drawn up by the authorizing officer of the Bureau of Land Management. Such stipulations would be similar or the same as the appropriate proposals listed under Generating Station.

Highway

If application is submitted for a highway right-of-way, the general requirements for highways over public lands, described above under Generating Station, would apply. Stipulations applicable to roads, listed above, would generally be required, as feasible, where the right-of-way would be on public lands. Fences would be required along the right-of-way and intersecting roads and trails would need to be supplied with gates, provided with cattle guards, or closed, as the authorizing officer directs, in order to reduce traffic hazards and risks to livestock.

Measures proposed by state and local entities

Generating station and mine

Under fuel consumption standards, Utah requires that coal or oil burned in any fuel-burning installation shall contain no more than 1.0 or 1.5 percent sulfur by weight, respectively. An exception can be granted if sulfur dioxide emissions would be controlled to levels equivalent to 1.0 percent sulfur coal or 1.5 percent sulfur oil.

On July 9, 1975, the Utah Air Conservation Committee adopted a change in their regulations that would remove the requirement of 80 percent control of sulfur dioxide for new sources. In its place, Section 1.3 and Section 1.7 were adopted, which state:

Section 1.3 Air Quality Degradation Regulated

> In areas of present high air quality where measured or estimated ambient levels of controllable pollutants are below the levels specified by applicable standards, any emission of pollutant to the ambient air must be shown to result in pollution levels, as determined by appropriate evaluation procedures, within applicable ambient air standards, and will be prohibited in any case unless shown to be controlled to afford the highest efficiencies and lowest discharge rates that are reasonable and practicable as specified in Section 1.7.

Section 1.7 Requirements of Pollution Control Equipment Specified

> In all areas of the state, air pollution control equipment and processes shall be selected and operated so as to afford the highest efficiencies and the lowest discharge rates that are reasonable and practicable. Reasonableness and practicability as determined by the Committee shall take into account, among other things, the concentration and characteristics of the air contaminant in the gas stream, technical feasibility for control, and cost benefit relationships.

Therefore, 80 percent control of sulfur dioxide emissions would be required if it is reasonable and practicable. At the minimum, however, Utah would not permit sulfur dioxide emissions to exceed national standards.

Utah also has statutes and regulations relating to water rights, water quality, rights-of-way over state lands, wildlife resources, occupational safety and health, and coal mine safety. Some of these statutes and regulations require authorization for specific uses and monitoring to determine compliance and effects of operations. The memorandum decision by the State Engineer, approving the participants' application for water rights, requires that reasonable precautions be taken to prevent game fish from entering the intake facilities and ash, fly ash, and other undesirable materials and poor quality water from the power plant returning to Lake Powell.

New town

Most of the statutes, rules and regulations that relate to possible mitigation of adverse social effects are not in the form of requirements. They are, therefore, discretionary. Nevertheless, they are significant because they

empower local governments to act in mitigating problems. Action under such authorization would be necessary before the mitigation could take effect, but the legal authority for taking such action constitutes the beginning of mitigation.

Local governments are empowered to assess and collect property taxes. As noted in Chapter II, the main source of local government revenue is property tax, and expected taxes generated by the proposed plant are itemized in Chapter III. This section deals with authorization that would allow those taxes to be spent in mitigation of some social impacts.

City commissioners and boards of trustees may designate and regulate abatement of injurious and noxious weeds, garbage, refuse or any unsightly or deleterious objects or structure, and may appoint a city inspector for the purpose of carrying out such provisions. Title 10 (Chapter II) of the Utah Code gives localities the right to spend public funds for eradication of such problems, if, upon notice, the land owner or occupant does not remove the weeds, garbage, refuse or unsightly objects.

Strictly enforced, this law could significantly mitigate problems that arise in makeshift trailer facilities. Problems of adequate disposal of litter and obsolete objects are often greater in trailer courts because of the limited storage space in trailers. In makeshift trailer courts, problems are intensified due to the lack of maintenance and caretakers. When an area has a concentration of many such trailer courts, the ability of local government to effectively respond is strained.

If most of the trailers in relation to the Kaiparowits project are in well-planned and maintained trailer parks, this problem may be minimized, and local governments could correct any exceptions through enforcement under powers enumerated in Title 10.

Effects of this mitigating measure would depend partly on legal interpretations. If the phrase in the Code that reads "refuse or any unsightly or

deleterious objects or structures" is interpreted strictly, perhaps it could be used to regulate the random parking of trailers in areas where few facilities exist to complement such an establishment.

Such interpretations and implementations must originate at the local level and are expected to be effective mitigating measures only if supplemented and itemized in local rules and regulations. Such rules and regulations are then subject to challenge in court, but courts have upheld zoning laws and restrictive convenants that demonstrably enhance the community. Efforts to establish such rules and regulations would encourage citizen participation in the local formative stages of such mitigation.

Pursuant to Title 26 (Chapter 14, section 4) of the Utah Code, the Utah State Board of Health adopted rules and regulations relating to public water supplies. Under Title 10 (Chapter 7, section 14) of the Utah Code, municipalities are authorized to fund and develop water purification and sewage treatment plants, giving priority to demands that would endanger health if not met. The Board of Health must approve all treatment plans and the Director of Health may require such modification as he deems necessary to protect public health and safety.

As towns grow, it is becoming increasingly common in the United States for governments to address policies that will accommodate pedestrians. Title 10 (Chapter 15) of the Utah Code addresses this subject, noting that separation of vehicular traffic from pedestrian traffic can promote convenience and public safety. Municipalities are authorized but not required to spend monies from the general fund for improvements necessary or convenient to the operation of such malls. Such expenditures can include a wide variety of aesthetic, convenience or cultural items; however, no funds have been appropriated or allocated for such actions. Establishment of physical facilities for community activities

would help mitigate the impersonality among residents, which frequenly accompanies high rates of immigration from various parts of the country. This Utah Code chapter is the possible beginning of a mitigating measure, since it opens the way for local initiative to relate town planning closely to some changing social needs.

Under Title 10 (Chapter 9) of the Utah Code, counties and cities are given enumerated planning and zoning powers. Zoning restrictions frequently isolate some nuisances that would otherwise infringe upon the well-being of citizens; they are, therefore, mitigating measures, especially in areas where rapid development is taking place.

Page, Arizona, has had a comprehensive planning and zoning law from its inception. However, some restrictive covenants for Page are not enforced and many cultural assets and amenities outlined in the plan have not been constructed.

The Utah Uniform School Fund allows for distribution of funds according to the number of pupils in each district. This would help in financing education in the expected boom town situation, but appropriations for building new facilities are made on the basis of individual evaluation of needs. Under Utah Law, faculty and operating expenses are met and distributed automatically as needs arise. The State Board of Education has authority to undertake some emergency building programs to meet sudden and critical needs.

Governor Calvin L. Rampton emphasized Utah's official concern over energy development and related needs by creating the Kaiparowits Planning and Development Advisory Council. This council has been given lead responsibility for all planning and proposals to provide services for Kaiparowits-related needs. Programs approved by this council would be expected to mitigate some social effects of the proposed Kaiparowits project. Some purposes of the council are to:

1. Function as a local clearinghouse for energy planning and development activities underway or proposed for Kane and Garfield Counties.

2. Through participating governmental and private agencies, identify and secure funding and other resources to assist in planning and development efforts related to the Kaiparowits or other energy projects in the two counties, as needed.

3. Direct and carry out specific energy related planning or development activities, as requested by the counties or other participating governmental units or agencies.

4. Function as the liaison and communication body between the private development corporations, community and federal, state and local agencies directly related to the Kaiparowits and other energy projects in Kane and Garfield Counties.

5. Implement a process whereby community input may be received and reviewed by the council and carry out a continuing public education program.

6. Coordinate Kaiparowits and other energy construction and development planning with county planning and municipal development so as to attempt to prevent an influx of workers and related population to areas where there are not adequate and attractive housing and related facilities.

According to the governor's executive order, any agency of local, state or Federal Government, any state or private university, or private developer initiating studies, plans or specific development proposals, affecting the utilization of energy resources shall first submit such studies, plans, or development proposals to the council for its review and recommendations to insure optimum coordination of energy resource development.

The new town plan approved by the council includes proposals which, if implemented, could mitigate some impacts. These would include impacts on aesthetics, administration, and funding of services (see New Town secrion, Chapter I).

Measures to conserve water in the Kaiparowits new town, if built, would include use of effluent from the sewage treatment plant for irrigation (eliminating the need for additional pumpage for that purpose). This measure would conserve water, if carried out as proposed. However, since the town plan

is not yet detailed, the amount of water that might be conserved is unknown. Also, the areas of application of irrigation water are unknown, and the potential effect on the soil cannot be determined.

In March 1975, the state legislature passed laws dealing with energy development. One law authorized prepayment of sales and use taxes by the companies so funds could be used to build roads and support schools. Another allowed more flexibility in planning and funding efforts when projects require simultaneous planning in more than one county. These laws, discussed in Chapter I, would alleviate the financial burden on local government that would occur without such mitigating legislation.

Highway

In their access road feasibility study of the Kaiparowits project, the Utah State Department of Highways noted that at least general mitigating measures would be possible with construction of the new highway. These are:

1. Unpaved highways would be watered during construction. This would reduce dust and possible impacts from dust, such as effects on plants and road users and construction crews, and reduced visibility.

2. At least portions of the new highway could be designed and constructed to blend with the surrounding country and reduce visual impacts.

Other impacts, according to the study, could be mitigated providing sufficient time is available for highway design to reduce deep cuts and fills, stream encroachments, and aesthetic impacts.

These measures are not site-specific. The Utah State Department of Highways has indicated more detailed studies would be required if the proposed project is implemented. In addition to more specific mitigating measures of the kinds mentioned above, horizontal and vertical alignments would be designed for safety.

Measures to be implemented by participants

The participants' proposal is set out in detail in Chapter I. Those parts of the proposal that would mitigate impacts to a different degree or in addition to measures required by law are presented here.

Generating station

The participants' policy on air quality has been stated as follows (Southern California Edison Co., July 1974):

> "Recognizing that air quality effects of power generation are an extremely important environmental consideration, the project participants have made these commitments:
>
> "To comply with applicable federal, state, and local air quality and emission standards and furthermore to do better than the standards where technology permits commercial application.
>
> "To participate in the technological development of control equipment and to use the best commercially proven equipment available for emission control at the time the station is constructed. The project is proceeding on the basis that the following levels of emission controls will be attainable: 90 percent SO_2 removal and 99.5 percent particulate removal."

The participants' proposal to reduce emissions from the generating station involves the following measures:

1. Utilize a low-sulfur coal that averages 0.42 percent sulfur by weight and 7.0 percent ash.

2. Install commercially proven particulate removal equipment capable of 99.5 percent particulate removal, thus meeting water service contract requirements. The participants retained the consulting firm of Bechtel Power Corporation to perform an engineering study of particulate abatement systems (Bechtel Power Corporation, 1974). Based on the study, the hot-side electrostatic precipitator was selected. When operating at full design capability and using average grade coal at maximum continuous load, the removal equipment would reduce unabated emissions of particulates from 2,078 tons per day or approximately 568,962 tons

per year to 10.3 tons per day or approximately 2,825 tons per year. If this level of operating efficiency is attained, daily emissions of particulate matter would be less than one-third of the maximum amount allowed by Environmental Protection Agency standards.

3. Install a sulfur dioxide abatement system capable of 90 percent or better removal of sulfur dioxide (SO_2). Based on the Bechtel Study, which considered seven commercially proven systems, and experience with pilot equipment at the Mohave plant (Southern California Edison, April 5, 1974; Weir, et al., 1974; Weir, et al., 1975), the horizontal wet lime system was chosen which would abate SO_2 emissions from 276 tons per day (75,555 tons per year) to 27.6 tons per day (7,555.5 tons per year). This would be about 400 tons per day less than the amount allowed by Environmental Protection Agency standards. However, this system would also result in 1,293 tons of sludge daily, using worst grade coal.

In addition, the participants propose to install stacks of a height that would provide the most efficient dispersion of flue gases. The plume rise model, developed by the Tennessee Valley Authority (Carpenter, et al., 1971), was utilized to determine the appropriate stack height that would allow the plume to rise above the terrain to the northeast during light wind, stable conditions. This set of conditions was considered to be the most critical in determining stack height. The analysis resulted in the selection of a stack height of 600 feet (183 meters) for the Fourmile Bench site.

According to studies performed for the participants (Radian Corporation, 1974), these systems would also reduce plume opacity to within national and state standards. The systems should also reduce the amount of radioactive materials contained in fly ash emissions and reduce emission of trace elements contained in fly ash, although there may be no reduction of volatile trace elements. However, the use of SO_2 scrubbers may reduce mercury emissions.

The participants selected these mitigating measures as the best available based on available experience, studies, and predictions. However, the participants believe they should not be irrevocably committed to these particular actions since methods developed in the future may provide better alternatives. However, the participants have not made a definite commitment to up-grade mitigating measures as new technology becomes available.

If the mitigating measures proposed by the participants are not utilized, or should they fail or operate less efficiently than predicted, emission levels would be greater than the averages given above (see Air Quality sections in Chapters III and V for a discussion of emission levels under a range of conditions). However, current studies and experience indicate that 99.5 percent particulate removal and 90 percent SO_2 removal are both feasible and reliable and that the likelihood of complete failure is remote (Bechtel Power Corporation, 1974; Weir et al., 1974; Weir et al. 1975).

In addition to emissions from the generating plant, air quality would be affected by generation of ash and dust.

Ash from coal combustion would be collected at the following rates under worst conditions:

Source	Collection Rate
Bottom ash and economizer ash	622 tons per day
Pulverizer mill reject	350 tons per day
Precipitator fly ash	2,479 tons per day

To reduce fugitive dust ash generation from these sources, the participants propose the following measures:

1. Bottom ash-pulverizer mill reject: Collected and stored in water-impounded hoppers. Transported in slurry pipeline to dewatering bins, prior to deposit in ash disposal area.

2. Economizer ash: Upon leaving the collecting hopper, sufficient water would be added to make a slurry for transporting, similar to bottom ash. Compaction of ash at the ash disposal site would minimize dust erosion until it is covered with an ash-scrubber sludge layer to establish a relatively insoluble mortar-like cover over the fill area.

However, success in revegetation attempts is not certain as discussed further in this chapter. If revegetation should not be successful, the foot of topsoil on the side slopes might erode completely in 4 years. If revegetation should succeed, plant roots could penetrate the soil and take up metals, such as vanadium, selenium, and barium. Since selenium is toxic to grazing animals, a thicker soil layer may be necessary. The participants have indicated that they would fence the ash disposal area.

3. Fly ash: Conveyed in an air lock system to storage silos, watered at the unloader to 20 percent moisture content and placed in hauling trucks.

Construction roads would be treated as necessary to reduce fugitive dust generation. The participants have not indicated exactly how this would be done, or where.

Ash haul roads would be paved with road-mix asphalt surfacing material. Spur roads for ash placement would be constructed as needed and stabilized with cement.

The measures which the participants propose for controling coal dust are described in Chapter I. These measures include use of water and nontoxic chemical sprays, paving material if necessary, and ventilating and screening equipment.

If these mitigating measures were to be implemented as proposed, the effects would be to reduce quantities of dust and ash and lessen potential safety and health hazards. However, the volumes of dust that could be produced

are unknown; therefore, the amount of potential reduction cannot be determined. Although several measures are aimed at complying with applicable federal and state standards, others, such as treating construction roads "as necessary" to reduce fugitive dust, imply wide discretion on the part of the participants.

Environmental monitoring programs, including on-going studies of meteorology and air quality to establish base-line information, would be used to evalaute environmental effects of the project. These studies are outlined in more detail in Chapter I. Meteorology, air quality and ecology studies were initiated prior to proposed construction and monitoring would be performed continuously during startup and operation of the generating station. However, there are no detailed, formal proposals for monitoring programs at this time.

Participants state that "data from these monitoring programs will be made available to applicable regulatory agencies." Data from these programs could also be valuable in evaluating many existing uncertainties in air quality such as the fates of trace metal element releases from fossil fuel combustion, long-term effects of fossil fuel emissions on the ecosystem, plume modeling validation and many other unknowns related to energy generation. The participants are presently negotiating an air and water monitoring program that would be acceptable to all federal and state agencies.

This information by itself would not serve as a mitigating measure, however, unless federal or state authorities and the participants are alert to warnings of potential environmental impacts and act to prevent them. Some mitigating measures proposed by the participants to reduce erosion, if effective, could also reduce dust generation.

The participants propose to construct a flood control reservoir below the fly ash-scrubber residue disposal site and a drainage ditch around the site to prevent erosion and to control excessive runoff, as described in Chapter I.

However, should side slopes of the fly ash-scrubber residue disposal site erode because of the 4 to 1 grade, the flood control reservoir would silt enough to lose part of its design capacity and no longer be able to handle a 100-year storm. Then the reservoir could wash out, creating a new gully that would work its way back to the fly ash-scrubber disposal site. Also the drainage ditch around the fly ash-scrubber disposal site could silt in from the eroding side slopes, and create a situation where erosion would be accelerated instead of prevented. This erosion possibility cannot be effectively analyzed due to lack of information available on the drainage ditch. If the system is properly constructed and maintained, the chance of failure would be small. To prevent the drainage system from filling, the participants indicate they would periodically remove silt. (See the Soils section, Chapters III and V, for discussion of possible impacts if this measure is not adequate.)

The chance of failure would be less than 1 percent for a well-designed and constructed retention reservoir. However, this would be true only during the life of the project, assuming no maintenance after abandonment of the generating station. The reservoir would then eventually be filled with sediment and finally be cut through by erosion, when much of the retained silt and waste material would wash downstream into Lake Powell and the Colorado River.

The power plant complex would have a drainage system to handle runoff from a 100-year storm and prevent flooding and erosion in John Henry Canyon. This proposal cannot be effectively evaluated because of the lack of information on drainage ditch design. Based on data used for analysis of runoff, minimum flooding to be expected from a 100-year, 6-hour storm would be 122.14 acre-feet from the power plant complex.

A number of measures are included in the proposed action to alleviate or reduce adverse impacts on ground water quality. Fly ash and scrubber sludge would be placed in the ash disposal area as a mixture that would have permeability

of only 0.1 foot per year. This would result in a percolation rate of about 3.5 feet in 35 years. Depth to ground water in this area exceeds 160 feet. Participants have made no commitment to reduce adverse impacts to ground water after abandonment.

Evaporation ponds at the plant site would be lined with a 2-foot layer of mudstone having a coefficient permeability of 0.05 foot per year (laboratory determination provided by participants), which should reduce seepage loss from the ponds to not more than 22 acre-feet a year. The mudstone layer would be covered with a 12-inch layer of on-site surface material (probably sand and sandy soil) to protect the mudstone from weathering, drying, or eroding -- which might reduce its effectiveness as an impervious seal. Theoretically, this would reduce the seepage loss for 20 years. Thereafter, there may be some seepage from the ponds, resulting in possible eventual contamination of ground or surface water.

A monitoring program would be implemented to detect leakage from evaporation ponds. The participants state that any detected break in the lining would be repaired. The monitoring program would include use of observation wells around the ponds or control ponds for measuring actual evaporation or devices to detect changes of temperature and conductance of the water in various parts of the ponds.

Seepage, if any, from the disposal area to underlying rocks would eventually percolate to Wesses Canyon. Assuming that the retention reservoir would be placed below the mudstone outcrop in Wesses Canyon, it would collect these seepage losses. Tests by the participants on soils in the vicinity of the proposed retention reservoir indicate the reservoir itself would be underlain by mudstones about 80 feet thick. Permeability tests have shown that the coefficient of permeability for the mudstone is 0.05 foot annually. This indicates the mudstone would make a good in-place lining material that would prevent any degradation of the ground water.

Measures to mitigate impacts on surface water supplies include water recycling and various other conservation practices. The proposed storage reservoir at the plant site would be lined with mudstone 6 inches thick. This should reduce the reservoir seepage loss from a possible 5,400 acre-feet per year to 300 acre-feet per year.

The following measures have been proposed by the participants, and would generally be in addition to measures that could be required by state and federal agencies.

Colored building materials would be used for structures to help them blend with natural surroundings. The plant site would be landscaped to help beautify the area.

Water, power, and communication lines would be constructed along the same corridors at Fourmile Bench. If implemented, these measures could reduce physical and aesthetic impacts by concentrating construction and maintenance in a relatively narrow strip, rather than over a larger area.

The participants also propose to revegetate all disturbed areas after construction has been completed. If successful, this would reduce new erosion and restore sediment loss to near pre-project levels. Methods and types of vegetation have not been specified.

However, as mentioned, success in revegetating in the Kaiparowits Plateau area is not certain. In areas of shallow soils (less than 18 inches in depth) as on much of Fourmile Bench, or soils containing gypsum or receiving less than 8 inches of rainfall per year as on East Clark Bench, the number of years of successful seeding establishment on disturbed areas would be 3 years out of 10 (about 30 percent). However, irrigation is not proposed by the participants, and therefore it is doubtful that these seedings would maintain themselves if irrigation should not be applied, due to natural aridity and low productivity capabilties of the soils.

With the exception of steep and rocky areas, such as in the canyon, all other disturbed areas could have successful seeding establishment 3 to 5 years out of 10 (30 to 50 percent probability of success). In these areas, vegetation could maintain itself after irrigation water is removed.

Much of Wesses Canyon, Wesses Cove and Missing Canyon would not be suitable for establishment of vegetation after disturbance because of the rocky nature of these areas and erodibility of what little soil may be found on the steep sites.

The participants have proposed the following additional steps to reduce soil disturbance and reduce possibilities of erosion:

1. Temporary facilities, such as construction staging areas, would be located in areas designated for construction late in the project schedule. This measure, if implemented, would reduce the total area of disturbance. However, the acreages involved in this measure have not been specified;

2. Grading would be minimized and as many trees retained as practical. Again, specific information is not available, and the effectiveness of this measure cannot be determined;

3. A balanced cut and fill procedure would be used where feasible in all projects requiring grading;

4. Roads and evaporation ponds would conform with natural contours to the extent possible;

5. Where feasible, existing roads and trails would be used during construction and for patrol purposes during operation of the project;

6. Where possible, major drainage channels would be left unimpaired by plant facilities. Although there would be an increase in runoff volume over that which existed prior to plant construction (as a result of more impervious surfaces due to facilities), the natural landscape along drainage ways would be preserved.

These additional proposed mitigating measures are general, rather than specific at this time, and do not specify locations. The proposals as stated, indicate that engineering practicalities would be important in final decisions. Therefore, given such limited information, the potential effects and degrees of success of these proposed measures cannot be evaluated. However, Figure IV-2 shows estimates of the mitigating effects of all proposed erosion prevention measures under conditions of 2-year 6-hour, and 50-year 6-hour storms. Successful revegetation and reclamation would generally reduce runoff and sediment yield.

FIGURE IV-2

Reduction of Acre-feet of Runoff and Sediment Due to Mitigation Measures

Drainage affected	Reduction in runoff (2 yr-6 hr storm)	Reduction in annual sediment
Warm Creek	4.73	0.06
Wahweap Creek	3.13	0.33
Lake Powell (sub-total)	7.86	0.39
Paria River	0.31	0.01
Total of Lake Powell and Paria River	8.17	0.40
Percent decrease due to mitigation	60	21%

Potential overall reduction in 50-year 6-hour storm is 71.60 acre-feet on 20 percent

	Acres revegetated after construction	Acres reclaimed after abandonment	Total
Power Plant	240	272	512
Water Pipe line	395	175	570
Proposed highway	125	-	125
Coal Mine	192	466	658
New Community	1,100	-	1,100
Aggregate site	88	332	420
Total	2,140	1,245	3,385

Mine

The participants have stated: "It is the full intention of the participants of this project that, whether they operate the mine or contract the operations, full adherence to applicable guidelines and regulations will be followed."

Few of the measures which the participants have proposed in the mining area would be in addition to those required by the Mine Enforcement and Safety Administration (MESA) and stipulations likely to be imposed by the Geological Survey, Bureau of Land Management, and appropriate state agencies.

In the mining area a corridor concept would be used where possible for all transportation and communication facilities such as roads, pipe lines, power lines and conveyor systems. This would reduce the area that might be impacted.

The coal mine water balance indicates that about 5.6 percent (about 173 acre-feet per year) of the water diverted from Lake Powell would be lost to evaporation, mostly from the clear water pond and sanitary evaporation pond. Loss of water by evaporation during coal mining activities would, in effect, be mitigated somewhat by using water collected from aquifer drainage for the mining operation. This would reduce demand for water from Lake Powell to the mine.

Surface disturbance due to activities aboveground and possibly due also to subsidence, would still occur despite mitigating measures. Measures proposed by the participants, if carried out, would generally tend to reduce disturbance, but more specific mitigating plans would be needed to achieve maximum feasible impact reduction. Measures to reduce subsidence plus safety and economic considerations in mining would actually prevent maximum extraction of coal, and would leave about 50 percent of the coal reserves unmined. Kaiser Engineering has developed a preliminary reclamation plan which includes as objectives the sealing of mine openings, revegetation, and return to natural appearance and present land use (grazing). The plan is general at this time. A more detailed plan would have to be approved by the Department of the Interior.

Contingency housing plan

The proposed contingency housing plan would involve development of portions of the new town in a time frame to support construction workers and their families. This plan was described in Chapter I since it is a proposal to which the participants have committed themselves in the event new town development should not occur soon enough to avoid hastily provided, ultimately unsatisfactory housing and services. The environmental impacts of the contingency plan would not differ from the new community, because the same site would be used and development would be similar to new town development and would eventually phase into a new community.

TRANSMISSION SYSTEM IMPACT AREA

Measures proposed by federal agencies

The following stipulations set forth by federal agencies apply only to the land administered by those agencies. However, if the permittee agrees in the right-of-way contract, the federal stipulations would also apply to private lands.

Many of the stipulations proposed by the federal agencies were also proposed by the participants. The section on measures proposed by participants only covers those not included in the preceding sections.

Forest Service

Stipulations

On National Forest Service lands participants would be asked to agree to stipulations that are supplementary to the right-of-way easements and to any facilitating permits. The following is a typical set of such construction stipulations, as provided by the Forest Service. After location details are finalized, the Forest Service would prepare detailed analyses of specific locations and would establish specific stipulations.

As a condition precedent to the granting of an easement/permit the participant (grantee) agrees to the following:

1. Before construction commences, a pre-work conference would be held between the participant, his contractor, and the Forest Service.

2. To designate a representative for field operations who would be the sole field representative of participant and participant's contractors in dealing with the Forest Service liaison officer. Said representative would be empowered on behalf of participant and participant's contractors to communicate with the Forest Service liaison officer and to receive and comply with all communications and decisions of the liaison officer.

Participant would keep the liaison officer informed of any change in the name of participant's contact representative for field operations during construction of the lines and related facilities. These two measures would ensure full understanding of all stipulations by participants and authorizing agency.

3. That construction would be suspended in whole or part when, in the judgment of the liaison officer, such suspension is necessary to prevent environmental damage, to obtain compliance with terms of this agreement, the easement, or other facilitating documents or to comply with declared fire emergencies. Such suspensions would be in writing from the liaison officer.

4. Before construction commences, join with the Forest Service in preparing the following plans:

a. A fire protection plan that would set forth in detail fire prevention, presuppression, and suppression measures that would be taken by the participant, its employees, contractors, and subcontractors and their employees in all operations during the construction stage. The participant would cause its contractors to comply with all provisions of the fire plan and of all burning permits issued for disposal of flammable materials.

b. A clearing and brush disposal plan that would set forth in detail procedures and standards applicable to (1) all clearing and disposal of merchantable timber and young growth in the right-of-way and (2) debris disposal, including debris removal from all streams. Such plan would include provisions for payment by the participant or its contractors for merchantable timber on lands of the United States to be cut, used, or destroyed in construction of transmission line and access roads or in clearing the right-of-way. Payment for merchantable timber will be at appraised value under timber settlement (Regulation 36 CFR 221.29) as determined by the Forest Service.

c. A revegetation and erosion control plan with the objective of protecting, restoring, or enhancing the landscape, protecting soil, and protecting or reestablishing vegetative cover.

d. A flagging plan with the objective of using different colors of plastic flagging to indicate various purposes (i.e., clearing limits, archaeological sites, etc.).

e. A transportation plan designating all construction access roads needed.

These measures would ensure all parties are fully aware of activities planned to take place.

5. To request through the liaison officer at least two weeks before needed, permits for constructing access roads, use of borrow areas, staging areas, and heliports. This measure would prevent unauthorized use of land.

6. To have a survey and inventory made of archaeological, paleontological, and historical sites within the area that would be occupied by the right-of-way and access roads. The survey must be conducted by an institution holding a valid antiquities permit acting as consultant to the participant. A formal report prepared by the participants' archaeological consultant would be submitted to the Forest Service. Such report would detail findings of the survey and make recommendations for archaeological protection. Avoidance would be the first priority as a protective measure. Excavation or salvage should be recommended only when no prudent alternative is available. If the report and its recommendations are accepted by the Forest Service, archaeological clearance to commence construction would be given in writing. If, during construction, participant encounters any archaeological, paleontological, or historical sites, construction would be suspended at such site and a report made to the liaison officer. The Forest supervisor may require participant to relocate the proposed transmission line facilities to avoid destruction of archaeological, paleontological,

or historical values or to delay construction until archaeological evaluation and salvage operations are completed.

These measures are required by provisions of the Antiquities Act of 1906, National Environmental Policy Act, Executive Order 11593, and Historical and Archaeological Data Preservation Act of 1974, and would minimize loss to archaeological sites.

All costs of inventory, survey, and salvage operations would be borne by the participant. All salvage shall remain the property of the United States and shall be surrendered to the Forest Service.

In addition, the participant would:

a. Provide a project archaeologist to monitor construction activities in regard to the archaeological resource during all phases of construction.

b. Flag the perimeters of archaeological sites that are to be avoided. Flagging would be done just prior to the construction period and removed as soon as construction activity has moved on.

c. Determine, through the project archaeologist and in consultation with the liaison officer, how much protection should be afforded individual archaeological sites.

d. Identify and protect, through the project archaeologist, archaeological sites encountered in other construction activities such as road building, prior to construction activities.

e. Arrange systematic surface collection and salvage if essential for archaeological sites that cannot be avoided.

f. Require employees of contractor and subcontractor to strictly observe laws regarding antiquities, including surface collection.

g. Restrict availability of all plans, profiles, and the archaeological inventory report to individuals directly connected with the construction in order to reduce the risk to the archaeological resource.

h. Promptly report "pot hunter" or vandal activity to the liaison officer.

These measures are in accordance with requirements of the National Environmental Policy Act, Executive Order 11593, and Historical and Archaeological Data Preservation Act of 1974, and would minimize loss to archaeological sites.

7. To perform all work with explosives in such a manner as not to endanger life or property. All storage places for explosives and flammable material would be marked "dangerous." The method of storing and handling explosives and flammable materials would conform to all federal, state, and local laws and regulations. Fuses would not be used in blasting.

8. That pilots and aircraft suitable for fire control operations would receive Forest Service inspection and certification. Availability of these aircraft for fire control purposes would be as provided for all project equipment in the fire plan.

9. To establish an air liaison officer and a means of communication with the Forest Service, FAA, and military to provide for safe operations during fire season.

10. To require any project aircraft to monitor an agreed upon frequency on all aircraft radios in order to provide instant communications.

These measures would help prevent fires and provide for participants aircraft to be utilized in the event fire occurs.

11. All fences owned or controlled by the United States crossed by this power line would be provided with a steel gate or cattleguard, or both, not less than 12 feet long, as requested by the liaison officer. The participant

would install these gates and cattleguards at his expense. Gates would be kept closed as directed by the liaison officer. All fences that would be crossed by the line or access roads must be braced before the fence is cut. All construction or maintenance would be done in accordance with specifications provided by the Forest Service. This measure would ensure access along the transmission line routes, and prevent damage to fences.

12. That fences, pipe lines, corrals, gates, and cattle guards damaged by project activities would be replaced or restored immediately to at least the original condition.

13. To pay for or replace signs accidentally destroyed and to promptly replace signs that are removed to avoid damage. Such replacement would be to the standard existing prior to the start of construction.

14. To paint skinned trees near road crossings with a tinted paint preservative when required by the liaison officer. This measure would reduce susceptibility to disease and insect infestation.

15. That on slopes of more than 40 percent and on sensitive areas such as archaeological sites, conventional logging practices using heavy equipment would not be allowed. This might entail the use of helicopters or horse logging. This measure would reduce soil disturbance and subsequent erosion.

16. That ropes, cables, or guys would not be fastened to trees for anchors.

17. That where pruning or trimming of trees is necessary the tree limbs would be cut off smoothly against the bole of the tree. These measures would reduce or prevent damage to existing trees.

18. To restrict cross-country travel to those routes established by the liaison officer. This measure would minimize erosion and vegetative disturbance potential.

19. To construct, reconstruct, or maintain temporary and permanent roads in a manner that would minimize erosion potential and conform to the standards as set forth in the transportation plan and the master road permit.

20. That construction vehicles and equipment would not be operated on temporary roads and on other areas, designated for equipment use if resource damage is likely to occur, as determined by the liaison officer.

21. To take reasonable precautions to locate, mark, and protect all public land survey monuments, private property corners, and forest boundary markers. In the event that any such land markers or monuments are destroyed in the exercise of privileges authorized by this permit, depending on the type of monument destroyed, the participant would see they are reestablished or referenced in accordance with (1) procedures outlined in the "Manual of Instructions for the Survey of the Public Land of the United States," (2) the specifications of the county surveyor, or (3) the specifications of the Forest Service.

To cut witness trees (those that must be cleared) 4.5 feet above the ground or 18 inches above the blaze, whichever is higher.

Further, the participant would cause official survey records as are affected to be amended as provided by law.

22. To provide for safety as follows:

a. Construct the transmission lines to conform with all applicable federal regulations regarding aircraft safety. The liaison officer may also require aircraft warning markers at selected locations.

b. Comply with speed limits established by the liaison officer on forest roads for purposes of dust control and public safety.

c. Perform dust control measures on all roads, staging areas, borrow areas, heliports, etc., when a loss of visibility due to dust causes a safety hazard.

d. Use of dust palliatives such as chlorides, oils, other chemicals shall require prior approval of the liaison officer.

e. Provide appropriate signing of roads and helicopter staging areas to provide for public safety, where considered necessary by the liaison officer.

f. Place warning signs in the center of temporary roadways when they are closed. These signs would be worded: "This Road Not Maintained for Public Travel" and shall be on a 24 x 24 inch standard warning diamond shape.

g. Appropriately sign roads and helicopter staging areas for public safety purposes, such as "Caution Heavy Truck Traffic" or "Be Prepared To Stop", where considered necessary by the liaison officer.

h. Place signs on towers to warn public of high voltage.

i. Provide flagmen, barricades, and other safety measures to ensure public safety as directed by the liaison officer.

These measures would help ensure compliance with OSHA and provide for public and worker safety.

23. To observe the following sanitation measures:

a. Remove or dispose all participant generated waste in a manner satisfactory to the liaison officer. The term "waste" as used herein means all discarded matters, including but not limited to human waste, trash, garbage, refuse, oil drums, petroleum products, ashes, and equipment. Construction campsites would be maintained in a sanitary condition at all times and garbage and refuse at those sites would be disposed of promptly.

b. Discharge sanitary waste only in approved sewage treatment plants and solid waste in approved sanitary landfills.

c. Follow a litter policing schedule on all roads associated with the project.

d. Prevent the release or disposal of used oil and other petroleum products on National Forest Lands.

e. Provide approved sanitary facilities at area of work concentration and at other areas if found necessary by the liaison officer.

These measures would help prevent contamination of ground or surface waters and soils.

24. To provide for wildlife protection and enhancement the following measures would be followed:

a. Prevent disturbance or harassment of wildlife, particularly during nesting or breeding periods, by helicopters or other equipment.

b. Leave selected slash piles for wildlife purposes as designated by the liaison officer.

c. Observe any road closures in effect for wildlife protection or management purposes.

These measures would help minimize disturbance or displacement of wildlife and increase habitat for some species.

25. To meet the following general environmental protection measures:

a. Confine construction activities to designated areas as approved by the liaison officer.

b. Restore disturbances from temporary construction facilities such as haul roads, work areas, structures, foundations of temporary structures, stockpiles of excess or waste materials, or any other vestiges of construction as directed by the liaison officer and revegetate in accordance with the revegetation and erosion control plan.

c. Prevent the operation of equipment in perennial streams except on a case-by-case basis as approved by the liaison officer.

d. Obtain the approval of the liaison officer for contractor use of water from National Forest sources (stock tanks, springs, creeks, etc.) on a case-by-case basis.

e. Abide by all federal, state, or local laws in securing water for construction purposes.

f. In forested areas provide screening where all roads intersect powerline rights of way. If necessary, plant trees (native to the area) as directed by the liaison officer.

g. Prevent the contamination of surface waters from waste water used in construction activity such as concrete curing, and foundation and concrete cleanup.

h. Use nonspecular conductor throughout, on National Forest Lands.

i. String the "sock" line by helicopter in areas specified by the liaison officer.

j. Use treated or dark painted towers to reduce the suns reflection.

26. To provide a performance bond as follows:

Before issuance of the easement grant, participant would furnish the United States a surety bond or other security (hereinafter called "bond") of such type and on such terms and conditions as are acceptable to the Secretary of Agriculture, in the principal amount of $100,000. Said bond would, at all times, be maintained in force and effect in the full principal amount until construction of the lines is completed and until the bond is released in writing by the Forest Service.

Said bond would have the purpose of: (1) ensuring the performance by participant of each and every obligation of participant under terms and conditions of this grant and any permit issued to participant by the United States in connection with the lines; (2) providing for immediate payment to the United States of any cost or obligation incurred by the United States in performing any said obligation of participant which in the judgment of the Forest Service,

participant has not performed satisfactorily; and (3) ensuring the payment, within the amount of said bond, of any final judgment.

These bonding requirements would be in addition to, and not intended to affect, all other requirements of law, nor would they be intended to limit in any way participant's liability under any provision of law.

27. To require its contractors and their employees to comply with all provisions of the easement, facilitating permits, project plans, timber sale contract, and these stipulations.

There may be several additional stipulations found necessary after field inspections of the final alignment and after plans and specifications are reviewed.

Additional administrative requirements of the Cleveland National Forest, California

Landscaping

1. Temporary roads would be obliterated immediately after serving their intended purpose unless otherwise requested by the Forest Service. Obliteration would include performance of the following work standards satisfactory to the Forest Service:

a. Removal of all debris and fill material and all culverts from natural drainage courses.

b. Grading of all natural drainage crossings to natural slope and contour.

c. Ground line would be returned to as near natural grade as possible by pulling the outside edge of road in against the cut bank where sections in cut are involved; a high berm would be constructed where necessary to prevent vehicle travel.

d. Reestablish vegetation.

2. The Main Divide road is proposed as a future scenic highway. Therefore, all vegetative and soil disturbance would be held to a minimum. As soon as need for vegetation and soil disturbance has ceased, the crest area would be restored to near natural condition and vegetation reestablished.

These measures would help reduce the visual aesthetic impacts of the proposal.

Erosion control

1. Where protruding ridges are diagonal across full slopes, either the ridge would be removed or a drainage structure provided to carry water to a natural drainage.

2. Where material is excavated for culvert installations, such loose material would not be placed below the culvert outlet.

3. Outlets of all culverts would be properly aligned with the natural stream course and energy dissipators supplied and installed to minimize drainage course disturbance.

4. Overside drains would direct water into natural drainage courses.

5. Temporary roads would not be used during or immediately after a rainstorm unless absolutely necessary.

6. Repair of all erosion damage would be accomplished as soon as it occurs to prevent further loss of material into existing drainages.

7. All temporary roads and other areas of soil disturbance would be contoured, strawed, fertilized, and vegetation reestablished.

8. Fill slopes would be stabilized by mulching, fertilizing, rolling, and establishing vegetation.

These measures would help reduce or prevent soil erosion potential.

Reseeding

Stabilization of "bare" soil would be in accordance with the following specifications:

1. Preparing site.

   a. Excavation slopes would be thoroughly cultivated to a depth of approximately 6 inches, as designed by the U.S. Forest Service.

   b. Any damage by erosion after completion of site preparation and before application of seed and fertilizer would be repaired.

2. Mulching.

   a. The area would be uniformly covered with rice straw, spread at a rate of 4 tons per acre, when the slopes are in a loose cultivated condition.

   b. The spread straw would be impacted into the soil with a roller. (The roller shall be of such design that it would work the straw into the soil sufficiently so the straw would not support combustion.)

3. Seeding and fertilizing.

   a. Fertilizer would have a guaranteed analysis of 14 percent nitrogen, 14 percent available phosphoric acid, and 7 percent water soluable potash, and spread at a rate of 500 pounds per acre.

   b. Seed would be well mixed and consist of a mixture as follows, or as modified by the Forest Service.

Seed Name	Percent by Weight
Soft Chess (*Bromus mollis*)	20.0
Italian Rye (*Lolium multiflorum* or *L. Wimmera*)	60.0
Pubescent Wheatgrass (Topar) (*Agropyron trichophorum*)	20.0
Total	100.0

c. Seeds would be uniformly spread over the erosion control area at the rate of 30 pounds per acre. Inert filler material, approved by the Forest Service may be used to facilitate spreading the seed.

4. Stabilization

a. Sequence of the stabilization operation would be to prepare the site, spread the straw, apply the seed and fertilizer, then impact. There would be no lapse between mulching, seeding, and fertilizing.

b. Areas of completed construction that are to be stabilized would be mulched, seeded, and fertilized prior to October 15. Between October 15 and April 1, areas to be stabilized would be stabilized concurrently with the completion of construction.

c. In the event hydro-seeding (spray-mulching) appears to be more applicable to this project, this might be substituted for the mulching-seeding technique above, as mutually agreed to by both parties.

d. Cut slopes would be stabilized.

These measures would help reduce soil erosion potential, but would increase fire hazard when established grasses have cured.

Navigation aids

Participant would install navigation red-colored balls or discs on that segment of the transmission line that parallels the U.S. Marine and Forest Service heliport west of the Cleveland National Forest. This measure would reduce the hazard to aircraft in the vicinity of transmission lines.

National Park Service

The National Park Service specifies that a grantee provide for archaeological and historical survey of the entire transmission line route by a professional archaeologist, in advance of any construction activities. Any significant archaeological resources would be described and evaluated for their National

Register potential. Should they meet criteria outlined in 36 CFR 800.10, they would be nominated to the National Register of Historic Places. The archaeologist report would be made available to the National Park Service, Arizona Archaeological Center, P.O. Box 49008, Tucson, Arizona, 85717.

These measures for the protection of archaeological and historical sites are required by provisions of the National Historic Preservation Act of 1966, National Environmental Policy Act, Executive Order 11593, and Historic and Archaeological Data Preservation Act of 1974.

Bureau of Indian Affairs and Indian tribal councils

Specific mitigating measures regarding tribal Indian lands proposed to be crossed have not been developed. Consent of tribal governing bodies must be obtained prior to authorization of rights-of-way across these lands. Detailed negotiations may be required before consent is granted, and in some cases tribes have declined to to grant consent. During this negotiation between utility interests and tribes, specific mitigating measures may be stipulated and agreed upon.

Bureau of Land Management bonding requirements

Immediately upon issuance of an electrical power transmission line right-of-way easement grant necessary for construction of the line, grantee would furnish the United States a surety bond or other security (hereinafter called "Bond") of such type and on such terms and conditions as are acceptable to the Secretary of the Interior, (the principal amount to be determined upon issuance of the permit). Said Bond would at all times be maintained in force and effect in the full principal amount until construction of the line is completed and until the Bond is released in writing by the Secretary of the Interior (43 CFR 2801.1-5f).

Said Bond would have the purpose of: (1) Ensuring the meeting of each and every obligation of the grantee under terms and conditions of this grant and any permit issued to grantee by the United States in connection with the line; (2) providing for immediate payment to the United States of any cost or obligation incurred by the United States in performing any said obligation of grantee which, in the judgment of the authorized officer, grantee has not performed satisfactorily; and (3) ensuring the payment, within the amount of said Bond, of any final judgment recovered against grantee for loss or damage to property of others, or for bodily injuries to or the death of any person in any way arising from or connected with the line.

These bonding requirements would be in addition to, and not intended to affect, all other requirements of law, nor would they be intended to limit in any way grantee's liability under any provision of law.

1. Any equipment repair areas, marshalling areas, camps and heliports on federally administered lands would be located at least 1/2 mile from the nearest residence, business or institutional structures. This measure would reduce impacts on local residents due to night repair operations, noisy equipment assembly practices and the noise of departing and landing helicopters. It is unlikely that noise from these activities could be completely isolated from urbanized areas.

2. Grantee would apply only water on disturbed areas during construction to provide for dust control as directed by the authorized officer. This measure would reduce dust and resultant visual intrusions caused by construction activities. It would prevent the use of other, perhaps harmful chemicals for dust control. Complete success would be expected in preventing the use of other chemicals. The amount of dust reduction would depend on the frequency of water application and weather.

3. Grantee would furnish the authorized officer, for approval 30 days prior to construction, a construction plan that would include, but not be limited to, road layout, material sites, assembly areas, campsites, tower sites, pulling sites, water resources, and oil and hazardous material spills clean-up plan. The construction plan would help prevent damage to sensitive areas by allowing for minor adjustments in alignments, work areas and tower sites. This measure would provide opportunity fpr the authorized officer to make necessary environmentally beneficial decisions that could not be made based on the detail presented in the existing proposal.

4. Grantee would furnish the authorized officer, for approval within 90 days following issuance of the right-of-way, a rehabilitation plan including but not limited to location and plant, species to be seeded, season of seeding, rate of seeding, how temporary roads and other disturbed areas would be rehabilitated. This would allow evaluation of the rehabilitation plan to insure that areas with rehabilitation potential would have rehabilitation efforts implemented. It is recognized that not all lands could be fully rehabilitated. No quantification is possible because of unpredictable geographic variables found along the transmission system upon which rehabilitation depends.

5. National Resource Lands used for temporary access roads, campsites, equipment storage, and other construction activities would be restored by grantee to their natural state insofar as practicable and in accordance with a rehabilitation plan prepared by the grantee and approved by the authorized officer. Whenever revegetation would be required under the rehabilitation plan, grantee would file a report with the authorized officer when such planting is completed. An evaluation by the authorized officer would be made after the first growing season to assure that revegetation, in fact, was successful. Revegetation efforts would continue until the authorized officer had determined that satisfactory

compliance had been made. This measure would insure that maximum effort would be made to accomplish maximum rehabilitation on temporary disturbed areas. The ratio of success cannot be predicted.

6. The grantee would, during rehabilitation efforts, remove all berms and waste ridges along the edges of temporily disturbed areas by spreading the materials over the areas from which they were removed. This includes soils, rock, and vegetative debris.

7. The grantee would scarify or rip on the contour, all crane pads, pulling and stringing sites, temporary roads and all other compacted areas. The scarifying or ripping would be fourteen (14) inches in depth or to bedrock, whichever is the shallower. These two measures would reduce compaction, increase infiltration rate and increase the rate of ground cover reestablishment, and therefore allow a more rapid return of flora and fauna. There may be some adverse effects on buried archaeological values. The degree of reentry of flora and fauna is not predictable.

8. The grantee would insure that all clearing including survey lines be done with hand tools except for roads, tower sites, or as otherwise approved by the authorized officer. Scalping of top soil and removal of low growing vegetation would not be allowed outside the road area, tower sites, and other sites described in the approved transportation plan. This measure would reduce water and wind erosion and allow resprouting of shrubs and other low growing vegetation, protect aesthetic values from degradation, protect archaeological and cultural values from needless destruction, accelerate the return of the natural wildlife habitat, and reduce the need for subsequent rehabilitation. It is believed that this measure would accomplish the intended purpose to reduce unnecessary surface disturbance.

9. Road drainage would be accomplished so as to minimize erosion. Side ditches, water bars, culverts and other drainage structures would be

utilized as directed by the authorized officer. This measure would prevent establishment of major new erosion and drainage patterns. Minor erosion would still take place even if this measure were fully implemented.

10. Grantee would identify springs or seeps that are: (1) located within 200 feet of the edge of the right-of-way; (2) located within 200 feet of any new access road; or (3) located within 200 feet of the boundaries of any marshalling or assembly areas. No construction would be permitted within these limits. This measure would greatly reduce the possibility of construction activities altering quality or flow of springs or seeps or the riparian flora and fauna associated with the spring or seep. Construction would be effectively eliminated at these sites.

11. Grantee would not use any water sources on national resource lands without written permission of the authorized officer. This measure would eliminate the problem of unauthorized removal of water that may be needed for livestock and wildlife.

12. Grantee would assemble all free standing towers on site unless permission to do otherwise were obtained in writing from the authorized officer. This would prevent loss of Joshua trees, saguaro cactus and other protected or rare and endangered plant species from being destroyed during transportation of towers. Aesthetic values would also be preserved. Full success would be realized from this measure.

13. The grantee would, prior to the construction or clearing of any roads or right-of-way; provide a vegetative survey of all proposed transmission lines and submit the survey to the authorized officer for approval. The purpose of the vegetative survey will be to:

a. Inventory and delineate the distribution of rare, protected, endangered, and threatened plant species listed in the environmental impact statement.

b. All endangered or threatened plant species are to be preserved in their native habitat to the extent possible. Transplanting to salvage these species should be considered as a secondary objective if loss of the protected plants appears certain.

Grantee would further comply with applicable federal and state regulations regarding endangered, threatened and protected species.

Inventorying and mapping endangered and threatened plant species along the proposed transmission lines will enable minor adjustments of roads, tower sites, streatching areas and marshalling areas. This could eliminate loss of some endangered or threatened plant species. The amount of mitigation is not known and will not be known until mapping of species is accomplished and exact location of roads, tower sites and other facilities is known.

14. Grantee would, unless otherwise directed by the authorized officer, dispose of vegetative debris under 8 inches diameter by chipping or shredding the vegetation onto the temporarily disturbed areas. Individual trees over 8 inches diameter would be spread over the cleared areas in piles of three or four trees per pile, with an average of three piles per tower. Other trees more than 8 inches diameter not needed for wildlife habitat would be chipped where possible. In dense brush areas, small piles of brush would be pushed into washes and drainages on the downhill side of the cleared areas. No additional vegetation would be cleared to construct brush piles. No brush piles would be constructed outside of the right-of-way. This measure would provide cover for small animals, reduce soil erosion, and increase the potential for revegetation by providing a soil mulch. Mulch is lacking in the desert environment and the presence of the mulch cover would reasonably be expected to as much as double the chances of revegetation.

15. In areas of low growing vegetative types designated for temporary disturbance, grantee would reduce said vegetation by pulling a 20 to 30 foot

rail behind a crawler tractor. This rail, when pulled at a 30° to 45° angle, would remove vegetation with little or no damage to root systems. This would reduce unnecessary vegetative disturbance and hasten recovery time of vegetation by allowing some resprouting to take place. Generally, grass species resprout if the roots and a small amount of stems or leaves remain. Some browse species will resprout and provide a partial vegetative cover in a shorter period of time than if seeds were used for site restoration. An estimated 60 to 70 percent of the total disturbed area could be railed rather than bladed. Such removal or disturbance of vegetation would be kept to a minimum.

16. Within 90 days after conclusion of construction operations, all construction materials and related litter and debris, including vegetative cover accumulated through land clearing, would be disposed of in accordance with instructions of the authorized officer.

17. Following completion of construction, crews would remove all excess materials from the right-of-way and dispose of all debris in a manner that would return the area as nearly as possible to its preconstruction appearance.

18. After construction, all access roads would be restored to conditions acceptable to private property owners and regulatory agencies. This would include removal of surplus buildings and equipment, lumber, refuse, fencing or any other items not at the site prior to construction. Any drainage deficiences would be corrected to prevent future erosion, and cut and fill areas would be restored to their approximate preconstruction condition. Revegetation of specific areas as required by regulatory agencies would also be performed.

19. After construction, access roads on the western system would be maintained to as near the original state as possible. Crews would not deviate from either alignment or grade of these roads while performing maintenance work, and vehicles would not be driven off existing access roads during routine maintenance work. Access roads on the southern system would normally be closed after construction

Patrol and minor maintenance of the southern route would be accomplished by helicopter. Major maintenance would be performed with the use of heavy equipment. These four measures would insure that litter would be removed from construction areas, marshalling areas, and along the right-of-way. They would decrease sediment yield after construction by closing the southern system and maintaining the western system roads for use of maintenance crews. They would also minimize additional visual disturbances by using existing roads. Increased access and pressure would be alleviated by closing roads on the southern system. Bond requirements would insure compliance with these measures.

20. Grantee would obtain a permit from the managing agency prior to removal of any materials from natural resource lands needed for construction or repair of disturbed improvements. This would prevent indiscriminate cutting of wood products for construction or maintenance. Products requested for construction or maintenance would be salvaged wherever possible from areas cleared for roads, tower sites and other disturbed areas (43 CFR 2801.1-1). The amount cannot be quantified since the quantity of products that would be needed is unknown. It would not totally eliminate all indiscriminate use of material.

21. Grantee would comply with all applicable federal, state and local laws and regulations concerning use of pesticides to prevent indiscriminate use of poisonous substances and reduce the chance of accidental loss of plant and animal life. The participants stated they would not use pesticides.

22. The grantee would contract three wildlife biologists, one of whom would have aquatic biology experience approved by the authorized officer to;

a. Inventory active and recently active raptor nest sites, including endangered or threatened species, protected desert tortoise and Gila monster habitat and dens and crucial habitat of other protected, national interest, unique species along the proposed transmission line route and submit inventory data for review and approval by the authorized officer:

(1) Based upon this inventory, the transmission line route would be located at least 2 miles from active or recently active nests of endangered or threatened raptors and/or identified crucial raptor habitat. This would eliminate at least 80 percent of the harassment by workmen of these species during the nesting and rearing season. This would alsc eliminate an access road within 2 miles of the nest that would promote public harassment of the site.

(a) If the authorized officer determines the transmission line route could not be so located, the participant would not perform construction work along the proposed route within 2 miles of any active endangered or threatened raptor nests and/or crucial raptor habitat during the nesting season (approximately February 1 through July 31).

This would possibly eliminate up to 40 percent of the harrassment of these species during the nesting and rearing season. The access road by the active nest would be open to the public and might allow undescribed harrassment of the nest by the public.

(2) Based upon the inventory of desert tortoise and Gila monster dens, no construction work or vehicle travel should be performed within 200 feet of an active den unless approved by the authorized officer. This would limit the disturbance to desert tortoise and Gila monsters in their dens. The number of individuals that could be disturbed along the transmission system is unknown.

(a) A wildlife biologist would be present on the job site during construction in crucial wildlife habitat areas or during seasonal periods vital to species involved. These measures would ensure that the habitat, including riparian vegetation necessary during bird migration, and members of endangered, threatened wildlife species would be protected or that disturbance to animals and habitat would be limited. The amount of mitigation is unknown (Endangered Species Act of 1973 and National Environmental Policy Act).

23. Except in those areas where access roads already exist, the participant would construct and maintain the transmission line by helicopter through the following areas to limit disturbances to wildlife:

a. Crucial Gila monster habitat in the Beaver Dam Mountains from the head of Cedar Wash to the point where the existing road ends in Cedar Wash, an approximate distance of 3 miles.

b. Across all streams, marshes, ponds, rivers, dry washes identified as crucial habitat for protected wildlife by the required inventory.

c. Through the San Jacinto Valley in critical habitat areas for the Steven's kangaroo rat.

d. Through Indio and Coachella Valley to minimize disturbance of habitat for the flat-tailed horned lizard and Coachella Valley fringed-toed lizard, existing roads and already disturbed areas would be used. These measures would ensure that habitat of endangered and protected wildlife species would be safeguarded or that the disturbance would be minimal since no new roads would be constructed into this habitat. Collecting will be reduced also (Endangered Species Act of 1973 and Natural Environmental Policy Act).

e. Across the critical deer, elk and antelope habitat identified on Sycamore, Perry, and Black mesas.

24. Except for the above stipulations, ground equipment could be taken into identified important and crucial habitat areas of endangered or threatened species and during the crucial season specified in these stipulations, only when specifically approved by the authorized officer on a case-by-case basis. This measure would reduce disturbance to the habitat and members of endangered or threatened and other species. The reduction cannot be quantified (Endangered Species Act of 1973 and Natural Environmenttal Policy Act).

25. The grantee would protect the endangered black-footed ferret and its habitat by:

a. Contacting a wildlife biologist, approved by the authorized officer, to conduct an intensive survey prior to construction to determine if the black-footed ferret exists on any of the prairie dog towns along the proposed route.

b. Should black-footed ferrets or evidence of their existence be found along the proposed route, the transmission line would be moved at least 1/4 mile away from the boundary of the prairie dog towns supporting the black-footed ferret. No roads, or disturbance would be allowed within 1/4 mile of any prairie dog towns containing the black-footed ferret. This measure would minimize potentially detrimental impacts to the black-footed ferret or its habitat by preventing workmen or equipment from entering ferret habitat (Endangered Species Act of 1973 and Natural Environmental Policy Act). This is not an absolute guarantee that the species would not be disturbed if present in any of the prairie dog towns, because improved access would increase incidental human visitation.

26. The grantee would not cause any disturbance to habitat of the Vegas Valley leopard frog in Las Vegas Wash. No towers would be constructed within Las Vegas Wash. The two towers bordering the wash would be constructed at the maximum possible distance (1,700 feet) apart. Vehicles and equipment would not be allowed closer to Las Vegas Wash than the normal operating distance around the bases of the two towers immediately adjacent to Las Vegas Wash. This measure would minimize potentially adverse impacts to the Vegas Valley leopard frog and its habitat by the participants. It would, however, have no effect in preventing the public from using this access road to the edge of the wash (Endangered Species Act of 1973 and Natural Environmental Policy Act).

27. No new material site would be allowed in crucial desert tortoise habitat, without approval of the authorized officer. This measure would lessen

desert tortoise habitat disturbance. Should the habitat areas be adequately known, this measure would be effective in preserving existing dens and preventing injury to individuals.

28. The grantee would use existing roads and bridges across all rivers, streams and washes except where specified by the authorized officer. This measure would ensure that riparian habitat would not be unduly disturbed by new road building. This measure is expected to be about 60 to 80 percent effective in protecting riparian habitat where traversed by the system.

29. To protect crucial deer and antelope fawning and wintering areas, plus elk wintering areas, the grantee would not construct any transmission lines or microwave sites during the times indicated in the areas described below unless permitted by authorized officer:

From November 5 through March 30 - in the big game wintering areas north and south of Williams, Arizona. These areas are crucial winter range for mule deer, elk and antelope.

From November 5 through March 15, in the Beaver Dam Mountains, which is a crucial mule deer wintering area.

From April 1 through July 1: (1) on Black Mesa, Perry Mesa and Sycamore Mesa from Rocksprings north to where the proposed route crosses Interstate 17. This is a crucial mule deer fawning area. The area 2 miles east of Bumble Bee is a crucial fawning area for antelope, (2) on the crucial antelope range on the Coconino Plateau. This measure would ensure that mule deer, antelope and elk in these areas would not be unnecessarily disturbed by construction during fawning and wintering seasons. If no exceptions were allowed by the authorized officer, this measure would be 100 percent successful. An unknown degree of disturbance would occur if the participants were granted exceptions to this measure.

30. To protect crucial desert bighorn sheep migration routes, no construction of the transmission line would be undertaken north and east of the

Black Hills and between the Black Hills and the McCullough Mountains in southern Nevada, from March 1 through April 30, and November 1 through December 31. This would minimize disturbance to desert bighorn sheep during their crucial migrations between these areas.

31. The grantee would install warning lights on top and midway down transmission towers where the proposed route crosses waterfowl and shorebird migration routes leading into Overton Wildlife Management area, and the Muddy and Virgin rivers, if the Nevada Department of Fish and Game study indicates a significant number of night flying birds would be killed by flying into the transmission towers and that the warning lights would significantly reduce such mortality. It is reasonable to believe that unlighted parts of towers and conductors would still be collision targets and an unknown number of individuals could be killed or injured.

32. Prior to construction or other surface-disturbing activities, the grantee would conduct an intensive survey and inventory of paleontological, archaeological, historical and cultural sites within areas to be occupied by the right-of-way, the communication sites, the access roads, and other ancillary facilities. Institutions and individuals conducting such work must possess a federal antiquities permit and be approved by the authorized officer. The results of survey and inventory would be provided to the authorized officer. This measure would ensure that all such sites evident on the ground surface would be known prior to potential disturbances, and protected from inadvertent loss as required by provisions of the Antiquities Act of 1906, National Environmental Policy Act, Executive Order 11593, and Historical and Archaeological Data Preservation Act of 1974. The surveys would probably not identify all sites present, but if adequately conducted, they should identify at least 70 percent of the sites.

33. The grantee would be required by the authorized officer to relocate proposed tower sites, access roads, communication sites, or other ancillary facilities if this would avoid damage or destruction to paleontological, archaeological, historical and cultural values. This measure would protect against needless loss of these resources, as required by National Environmental Policy Act, Executive Order 11593, and Historical and Archaeological Data Preservation Act of 1974. The number of sites that would be avoided by this measure is unknown. This measure could be completely effective depending on adequacy of the initial survey.

34. Should evidence of previously undiscovered paleontological, archaeological, historical or cultural materials be exposed by ground disturbance during construction, grantee would suspend construction activities in that area until appropriate professional evaluation of the find had been made, and avoidance measures or salvage operations, if judged necessary, implemented. This measure would reduce undocumented and unmitigated destruction to sites not evident during survey, as required by provisions of Executive Order 11593 and Historical and Archaeological Data Preservation Act of 1974. An unknown number of sites could be discovered in this fashion.

35. After adjustments to tower, road, laydown, marshalling, parking, camp, communications and similar locations as a result of survey and inventory or onsite avoidance decisions, grantee would resurvey the proposed new locations for these facilities and the results would be provided the authorized officer. This measure would protect sites not previously subject to direct impacts that could become endangered as a result of changing construction locations. This is required by provisions of National Environmental Policy Act, Executive Order 11593, and Historical and Archaeological Data Preservation Act of 1974. This measure, combined with preconstruction surveys, should be nearly 100 percent effective in accounting for paleontological and cultural values.

36. Uncontrolled small test excavations, or exploratory "look-ins" to determine site depth or content, would not be conducted as part of survey unless justified on an individual site-by-site basis in the grantee's permit applications, or approved by the authorized officer. This measure would provide for minimizing loss of site integrity and destruction of data as required by provisions of the Antiquities Act of 1906, Executive Order 11953, and Historical and Archaeological Data Preservation Act of 1974. Present information does not allow quantification of the number of sites for which tests might be justifiable.

37. Salvage excavation would be the chosen mitigation measure only when the grantee could fully justify excavation as a last resort, and when the grantee could demonstrate that no other possible measure could be employed to preserve the site and the site data in their original condition and context as found. This measure is to assure that all practicable solutions to site protection and preservation would be exhausted prior to making decisions to disturb site integrity, as required by National Environmental Policy Act, Executive Order 11593, and Historical and Archaeological Data Preservation Act of 1974.

38. Grantee would provide qualified professional archaeologists approved by the authorized officer for continuous on-ground inspection of all construction areas during all ground-disturbing construction phases. This measure would provide for qualified surveillance and evaluation that would protect the resource base as fully as possible, as required by National Environmental Policy Act, Executive Order 11593, and Historical and Archaeological Data Preservation Act of 1974. The measure would also relieve the burden of decisions from the authorized officer, and reduce time loss when unexpected discoveries and resulting suspension of work during construction required professional consultation.

39. The grantee, contractors, and subcontractors would specify and enforce strict sanctions against any willful actions by employees that could in

any way be injurious to paleontological, archaeological, historical, and cultural sites and materials. Vehicles and equipment would be operated only in specified areas receiving prior clearance. Collection of artifacts and fossils on right-of-way, and exploration and/or collection off right-of-way would not be allowed. This measure would ensure against uncontrolled loss to the resource base through acts of individuals, whether well-intentioned or otherwise, and would apply to preconstruction, construction, clean-up, and maintenance operations. The measure is required by provisions of National Environmental Policy Act, Executive Order 11593, and Historical and Archaeological Data Preservation Act of 1974. An unknown loss would still be expected to occur.

40. Measures proposed by federal agencies for protection and preservation of paleontological, archaeological, historical, and cultural properties would be applied by the grantee as uniformly as possible throughout the transmission system, regardless of whether the lands are controlled by federal agencies, state agencies, local agencies, or private individuals. These measures, to protect all such resources located within the project area, are required by provisions of the Antiquities Act of 1906, Historic Preservation Act of 1966, National Environmental Policy Act, Executive Order 11593, and Historical and Archaeological Data Preservation Act of 1974. Applicability to lands not directly under federal administration is provided specifically by the Historic Preservation Act of 1966 and Historical and Archaeological Data Preservation Act of 1974.

41. Grantee would at all times locate transmission and communication facilities to take advantage of natural topography and vegetation to screen structures from public recreation areas and highways.

42. Grantee would comply with all other reasonable measures the authorized officer deems necessary to ensure that transmission and communication structures harmonize as much as possible with their natural surroundings in areas exposed to public view.

43. Grantees would ensure that towers, conductors, and microwave repeater facilities have dull or nonreflective finishes, or be colored to blend with the landscape where they must be located in or near areas of high scenic value. Refer to Chapter II, Illustration 51, for location of areas of high scenic value.

44. Participant would ensure that wherever vegetative clearings were necessary in areas exposed to public view, clearing edges would be left with irregular boundaries and not straight lines. Trees, shrubs, grasses, and topsoil not removed would be protected from damage during construction.

45. Grantee would ensure that temporary roads be obliterated immediately after serving their intended purpose unless otherwise directed by the authorized officer. Obliteration would meet the following work standards to the satisfaction of the authorized officer.

1. Removal of all debris, fill material and all culverts from natural drainage courses.

2. Grading of all natural drainage crossings to natural slope and contour.

3. Ground line would be returned to as near natural grade as possible by pulling the outside edge of road in against the cut bank where sections in cut are involved. A high berm would be constructed where necessary to prevent vehicle travel on closed roads (Southern System).

4. Reestablish vegetation

This measure would reduce or prevent vehicular entry into areas where such activity is not advisable, and would thereby mitigate likelihood of environmental, cultural, and aesthetic disturbance and risks to travelers.

46. Grantee would ensure that material from earth slides and other sources requiring removal from the road would neither be deposited in streams or stream channels nor sidecast onto vegetated slopes or other locations where it

would erode or wash into streams and cause damage through siltation of streams and reservoirs. These six mitigating measures would ensure that, wherever possible, structures and facilities would have minimal visual impact. Substantial visual intrusions would still occur due to the lack of screening vegetation and high relief topography over much of the transmission system.

47. The grantee would construct and maintain the transmission lines by helicopter through the following sensitive areas:

a. Kaiparowits Plateau - The southern tip of Horse Flat for approximately 2 miles.

b. Cockscomb Ridge - from the top of the Kaiparowits Plateau down the mountain across Brigham Plains, then to the bottom of the gulch along Paria River, a distance of approximately 3/4 of a mile. Also, at the point where the proposed route crosses Cockscomb Ridge, a distance of approximately 1 mile.

c. Kanab Creek

d. Hurricane Cliffs - Grantee would use existing roads and not construct a road down the face of the Hurricane Cliffs.

e. Beaver Dam Mountains - from the head of Cedar Wash to where the existing roads end in Cedar Wash, an approximate distance of 3 miles.

f. Virgin Mountains

g. Las Vegas Wash

h. Virgin River Recreation Lands

i. Cottonwood Cliffs

This measure would ensure minimal surface disturbance, including soils and vegetation, in sensitive areas, and leave fewer visual intrusions. It would also ensure protection of wildlife habitat. The grantee's cooperation is expected to make these measures fully effective.

48. Grantee would use long spans to cross roads and highways with transmission lines. Towers would be placed as far back from the highways as possible and vegetation between towers and the highways would not be cleared. This measure would lessen visual impact of transmission lines at highway and other road crossings. This measure would only slightly reduce the visibility factor at such crossings.

49. Where no roads presently exist, grantee would construct and maintain new communication sites only by helicopter. No new access roads would be allowed unless otherwise approved by the authorized officer. This measure would prevent excessive or unnecessary disturbance leading to the sites. The visual impacts, soil disturbance, and erosion would be eliminated in those areas.

50. Grantee would make contractors and their employees aware of, and encourage them to abide by "Rules of Conduct" as stated in 43 CFR 6010.2 (1974) when operating on national resource lands administered by the BLM. This chapter should be available to all personnel and, consistent with the purposes of the lease or permit, the rules should be strictly followed. These measures would prohibit destruction of natural features, objects of historic or scientific interest, and signs, markers or other public property. Since basic rules of conduct apply to all individuals on the land, and since it is recognized that not all persons would honor the "rules," an unknown number of infractions would be apt to occur.

51. During construction, grantee would regulate public access and vehicular traffic as required to facilitate construction operations and to protect the public, wildlife, and livestock from hazards associated with the project. For this purpose, grantee would provide warnings, flagmen, barricades, and other safety measures as deemed necessary by the authorized officer (43 CFR 2801.1-5(a)). Advance warning would allow recreationists and others to avoid

construction areas and would help minimize conflicts between construction and recreational activities. Some inconveniences would occur to recreationists and public travelers but the resources would be protected. A limited number of conflicts would be expected to occur.

52. The grantee would rebuild and repair such roads, fences and trails as may be destroyed or damaged by construction work and would build and maintain necessary and suitable crossings for all roads and trails that intersect the works constructed, maintained, or operated under this grant. All gates on public lands would be closed but not locked (43 CFR 2801.1-5(e)). This measure would ensure that access to public and private recreation areas or driveable public roads would not be lost as a result of the contractor's construction operations, and that such access would be maintained after the project has gone into operation. This measure should be 100 percent effective.

a. The grantee would close those roads designated by the authorized officer and the wildlife biologist in areas of critical desert tortoise habitat. This measure would prevent 70 percent of the future human travel into crucial desert tortoise habitat in which the roads are closed.

53. Grantee would install cattle guards or gates where construction operations must intersect and disturb existing fences. The type and kind of facility would be determined by the authorized officer. This measure would facilitate livestock handling where fence crossings do not now occur. It would also prevent trespass of livestock across existing fence boundries. Immediate installation of such facilities would result in 100 percent effectiveness of this measure.

54. Grantee would pay the United States full value for all damage to the lands or other property of the United States caused by grantee or by his employees or contractors, and would idemnify the United States against any

liability for damage to life, person or property arising from the occupancy or use of the lands under the right-of-way. Provided, however, that if grantee has no legal power to assume such a liability with respect to damage caused to lands or property, grantee in lieu therof would agree to repair all such damage (43 CFR 2801.1-5 (f)).

55. Grantee would abate any condition existing with respect to the line that would cause serious and irreparable harm or damage to any person or property. Any property or resource harmed or damaged by grantee in connection with the line would be reconstructed, repaired and rehabilitated by grantee to the written satisfaction of the authorized officer (43 CFR 2801.1-5(h)). The above two measures address themselves to impacts discussed under livestock grazing, recreation, agriculture and transportation facilities in Chapter III. Livestock, wildlife facilities, land improvements (fences, cattle guards, agricultural products), human life, roads and other rights-of-way improvements (pipe lines, telephone lines) that might become damaged or destroyed during course of construction through fault of the grantee or his contractor, would be rectified either monetarily or by replacement. Human and animal life cannot be replaced, but monetary compensation could be initiated to help ease such hardships. The measures would not mitigate direct impacts involved but would help eliminate accidental or careless damage to personal and public property situated on or near the proposed project.

56. If grantee requires mineral materials from the national resource lands, Resource Lands, application would be made under applicable regulations for such materials. Grantee would submit a plan of operation in accordance with 43 CFR, Part 23. No material would be removed by grantee without written approval of the authorized officer. Insofar as possible, use of existing material sites would be authorized in preference to new sites (43 CFR 3601.1). This measure should eliminate any possibility of illegal extraction of mineral aggregate from

national resource lands. It would help ensure that mineral aggregate sites would be selected with full consideration of aesthetics and other resource values and not convenience alone, and that the sites would be restored to their near original condition through leveling and revegetation. Based on past experience, it is believed that for large quantities of material (batch plant site), this measure would be 100 percent effective. For small quantities, some random removal possibly could occur.

57. Grantee would do everything reasonably within its power, both independently and on request of any duly authorized representative of the United States, to prevent and suppress fires on or near lands to be occupied under the right-of-way, including making available such construction and maintenance forces as may be reasonably obtainable for the suppression of such fires (43 CFR 2801.1-5(d)). This measure would assist in eliminating fire damage that could be hazardous to human life, animals, vegetation and property. It would not prevent all fires, but the severity of such fires as might occur could be limited.

58. Grantee would, on a daily basis, remove or dispose of all waste in a manner consistent with federal, state and local laws and regulations. The term "waste" as used herein means all discarded matter, including but not limited to, human waste, trash, garbage, refuse, oil drums, petroleum products, ashes, and equipment. Campsites would be maintained in a sanitary condition at all times and garbage and refuse must be disposed of at designated sites (43 CFR 2801.1-5(b)). These measures would help prevent fires, eliminate the visual intrusions caused by waste and eliminate possible sanitation problems. It is possible that the grantee or his contractors would not observe these daily disposal requirements, thus investing one or more of the undesirable effects listed in the measure.

59. Grantee would maintain constructed transmission lines and permanent access roads in a manner to assure an adequate state of repair, and safety

standards acceptable to applicable regulatory agencies (43 CFR 2801.1-5(h) and 43 CFR 2851.1-1(a)(1) and (2)). This measure would ensure that the grantee utilize the rights-of-way in a safe manner, and that other authorized uses of the rights-of-way not be impaired in any way due to a lack of maintenance. It is anticipated the grantee would observe this measure for his own benefit.

60. All fences, gates, cattleguards, trailers or other objects or structures that could become inadvertantly charged with electricity shall be grounded.

Measures proposed by state and local entities

In preparation of the statement, various state and local entities were contacted for recommended mitigation measures. Those recommendations based on statutory authority are included below. Since these inputs are general and regulatory in nature, it is not possible to analyze potential mitigating effects.

1. The Arizona Native Plant Law provides legal framework for protecting native plants along the Arizona portions of the transmission system.

2. The Arizona Electric Transmission regulations regulate transmission line construction within Arizona.

3. The Resources Agency of California proposes the following measures on California segments of the transmission system, as required by California Public Resources Code and California Penal Code: Antiquities:

a. If archaeological artifacts should be discovered during construction, we recommend the sponsor immediately consult with a professional archaeologist.

b. As additional historical values may exist, we suggest consideration be given to identify and safeguard any potential historical resources that may not be presently recorded on any state or federal register.

4. California Public Use Permits must be submitted to counties and municipalities under provisions of Sections 6001 and 6201 of the Public Utilities Code to expand or construct substations.

Identified statutory and administrative requirements for the entire transmission system are listed in Appendix IV-2.

Measures to be implemented by participants

The following measures proposed by the participants are general rather than specific and do not specify locations or methods for accomplishment. Therefore, given this limited information, the potential effects and the degree of success of these measures cannot be evaluated.

Electric and audible noises from the project would be kept to acceptable levels. Maximum audible noise levels would be 55 db(A) at edge of the right-of-way during worst conditions (i.e., fog, drizzling rain, or snow). The transmission line would be designed to meet requirements of the Institute of Electrical and Electronic Engineers (IEEE) Working Group No. 3, "Radio Noise Design Guide for High Voltage Transmission Lines," IEEE Transmission Power Aparatus and Systems, Vol. 90, pages 833-842, March/April 1971, of 40 decibel at 100 feet lateral distance from the outside phase.

During construction of transmission lines in areas where fire hazards exist, all vehicles and gas-powered equipment would be equipped with spark arresters. A fire patrolman would be onsite with a pumper-equipped pickup truck when necessary. If required, fire-fighting equipment would be located in cache boxes along the right-of-way at strategic locations. All welding, grinding operations, and smoking privileges would be controlled in fire-danger areas. When weather conditions create an extreme fire danger, construction operations would be either limited or curtailed as required by regulatory agencies. The construction engineer or general foreman would establish a project fire plan and all project personnel

would be instructed as to individual responsibilities in implementing the plan. These measures should reduce fire hazards along the proposed project, and provide quicker initial fire suppression efforts.

Participants would transfer any combustible waste material from the site by airlift, or by truck where roads exist for appropriate disposal.

While maintaining transmission lines and patrol roads, all personnel would be required to make every effort to protect all species of plants and wildlife, and all resources of historical and archaeological value. This measure would ensure that protection of these resources would continue after completion of the construction phase of the project.

Participants would assure that reasonable precautions are taken to protect, in place, all public land survey monuments, private property corners, and forest boundary markers.

Contact would be made with directly-affected local residents and property owners to inform them of the planned project and what may be expected during each construction phase such as the hours of operation and types of construction equipment that would be used in the area. Potential problems would be documented prior to construction whenever possible. This measure would reduce friction between the applicants and local residents and landowners.

In the event of conflict between the participants' specifications and requirements of the governing agency, requirements of the governing agencies would take precedence.

After construction, temporary access roads would be restored to conditions acceptable to private property owners. This would include removal of surplus buildings and equipment, lumber, refuse, fencing or any other items not at the site prior to construction. Any drainage deficiences would be corrected to prevent future erosion, and cut and fill areas would be restored to the approximate

preconstruction condition. Revegetation of specific areas as required by regulatory agencies would also be performed to reduce soil erosion potential.

LIMESTONE QUARRY IMPACT AREA

Measures proposed by federal agencies

Forest Service Regulations (36 CFR Part 252) provide for protection and conservation of nonmineral resources that might be affected by development of mining claims on National Forest Lands, as well as reclamation and bonding. The requirements of these regulations include analysis of the proposed project prior to any development, and determination as to whether an environmental impact statement might be required. The development plan must be approved by the Forest Service, and operations must be conducted in conformance with an approved plan. Special use permits and rights-of-way may be required for ancillary operations on the National Forest, if such operations are needed.

The above regulations require the Forest Service to develop stipulations in accordance with appropriate statutes and regulations regarding protection of human environment, including air, water, vegetation, wildlife, and archaeological, paleontological, and historical values. The participants would be required to comply with these stipulations. All regulations concerning safety and health would also be applicable.

The Forest Service would require the participants to develop a back-filling, shaping, top soil replacement and revegetation plan for mined-out areas. Forest Service approval of the plan would be required prior to start of quarrying operations. Other site-specific stipulations may also be required by the Forest Service. The purpose of these administrative measures would be to comply with the regulations cited above in mitigating probable impacts of the proposed project.

The proposed limestone haulage route would cross part of Bryce Canyon National Park. Under Title 36, Code of Federal Regulations, 4.11, the Park Superintendent is responsible for regulating heavy equipment travel within his jurisdiction.

The National Park Service may confine movement of limestone haulage trucks through Bryce Canyon National Park to night-time hours to reduce potential hazards and interference with visitor traffic. Covering of the trailers may also be required, to prevent risk of limestone fragments dropping on the highway, as well as to reduce dust.

Measures proposed by state and local entities

Utah Executive Order of August 27, 1974 requires impact statements for major state actions, including development of mineral leases on state lands. In addition, all proposed actions involving mining, permits for transmission lines, roads, water pipe lines or other facilities on state lands would be in conformance with appropriate state laws and regulations. Water rights would have to be obtained from the State of Utah, and their continuation would be subject to conditions imposed by the state.

Limestone haulage on state highways would have to be in accordance with state laws and regulations concerning vehicles, traffic, and use of the roads. All operations would be subject to Utah laws regarding safety, health, sanitation, solid waste disposal, and air and water pollution control.

If deemed appropriate, the state may require that all springs in the area be monitored by participants during the life of the quarry to detect changes in flow rate or chemical composition of the water. A monitoring system would determine if ground water is being depleted.

Such measures would be intended to protect water use downstream in the Sevier River drainage, by determining whether the quantity and quality of water would be affected by the proposed operation. these measures be effective in mitigating undesirable effects if monitoring indicated potential impacts and steps were taken to prevent their occurrence.

Measures to be implemented by participants

The participants' proposal is set out in detail in Chapter I. Those parts of the proposal related to mitigating measures are summarized here. These measures are general, however, and do not specify locations or, in most cases, particular methods. Therefore, the potential mitigating effects cannot be accurately evaluated. However, an analysis of these proposed measures is given at the end of this section.

The mined-out area would be backfilled and shaped to conform with existing topography, top soil would be spread and the area reseeded to species suitable for livestock and wildlife. Trees may also be planted. Revegetated areas would be fenced, if necessary, to prevent livestock from feeding in newly reseeded area. A total of 110 acres may be reclaimed after abandonment of the operation.

Utah prairie dog towns and sage grouse booming grounds would be avoided by access routes.

Clearing of trees on the quarry site would be coordinated with the Forest Service to allow scheduling for sales of all marketable timber. Approximately 50,000 board feet of commercial ponderosa pine and an unknown quantity of pinyon pine "firewood" could be harvested.

Quarry layout and design would take advantage of existing natural topography to lessen visual impact as follows:

a. Leaving ridge-line timber so cliff slopes would appear undisturbed when viewed from Johns Valley.

b. The shop/office complex would be located to the side of a gap in the ridge so the facility could not be seen from Johns Valley.

c. Construct the access road on a curve to minimize visual contact.

d. Conduct all quarrying on the back slopes of ridges viewed from Johns Valley.

e. All structures would be restricted in height to prevent visibility from Johns Valley.

f. All building and structures would be painted "earth tone" colors to blend with existing scenery.

Water would be used to control dust during limestone handling and haulage operations. Water would be sprinkled on roads, broken limestone at the face and on the stockpile to control dust when needed. Nontoxic dust-suppression solutions may be added to further mitigate sources of fugitive dust.

Possible soil contaminants such as solid and liquid wastes and oily material would be trucked to a sanitary landfill at Panguitch. A septic/leach tank would be constructed to serve the office/shop area and portable sanitary facilities provided at remote work sites.

These measures would not completely mitigate all impacts. Concurrent, successful reclamation could reduce disturbance, but some surface lowering in the mined-out area would occur. These effects could include changes in soil water content, small scale changes in drainage, and sediment collection in depressions. Even though revegetation might be successful, it is unlikely that 15 to 20 acres of steep slopes would be revegetated. The probable mitigating effects of measures proposed to reduce erosion are presented in Figure IV-3.

FIGURE IV-3

Reduction in Runoff and Sediment Yield Due to Mitigation

	Reduction		
	Runoff		Sediment Yield
	(2 yr-6 h)	(50 yr-6 h)	
Acre-Feet	1.00	2.40	-
Percent of Total	47	28	

Acres Revegetated After Construction	Acres Revegetated After Abandonment	Total
0	130	130

Cattle guards and fences would be effective in protecting livestock only if adequate and maintained. Avoiding sensitive wildlife areas by rerouting access routes would not necessarily prevent some disturbance, especially that due to noise and additional people. Although cleared trees could be harvested, the loss of trees in the area could remain a long term effect unless revegetation included successful tree plantings.

Screening the site by layout and design should be effective, especially since the quarry site is not readily visible from Johns Valley.

KAIPAROWITS

ENVIRONMENTAL IMPACT STATEMENT

CHAPTER V

ANY ADVERSE EFFECTS WHICH CANNOT BE AVOIDED SHOULD THE PROPOSAL BE IMPLEMENTED

final

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SUMMARY

Climate

No significant impacts on climate have yet been measured in the Southwest as a result of emissions from large coal-fired power plants and no significant impacts on climate would be expected from the Kaiparowits power plant or associated transmission system.

Air quality

The addition of air pollutants including sulphur dioxide (SO_2), nitrogen oxides (NO_x), particulates, trace elements, cooling tower salts, coal mine emissions, coal dusts, auto and truck emissions, and fugitive dusts is an unavoidable impact of varying degree to the presently minimally polluted atmosphere of the region.

Hourly emissions that would come from the generating plant after abatement are estimated at 0.58 tons of particulates, 2.17 tons of SO_2, and 10.42 tons of NO_x using worst grade coal at 100 percent load, assuming 99.5 percent control of particulates and 90 percent control of SO_2.

Minimum control efficiencies to meet applicable air quality standards are calculated to be 99.1 percent control for particulates and 82.8 percent for sulfur dioxide. The resulting hourly emission of particulates would be 1.05 tons, and 3.72 tons for SO_2 using worst grade coal at 100 percent load. The differences in the two sets of numbers are the differences between what is proposed by the participants as compared to the maximum emission rates calculated as allowable under present regulation.

Although within federal and state limitations, emissions would result in some unavoidable deterioration of air quality. The proposed site at Fourmile Bench lies within a 100-mile radius of a number of National Parks, National Recreation Areas, National Monuments, and National Forests, all of which have the potential for redesignation to a Class I area in which practically any change in air quality would be considered significant. The National Park Service (1976) feels that the operation of the Kaiparowits plant would result in air quality impacts that are adverse to the legislative purpose of Glen Canyon National Recreation Area and Bryce Canyon National Park. The relevant extracts from the appropriate legislation are as follows:

> Glen Canyon NRA was established "...in order...to preserve scenic...features contributing to public enjoyment of the area..." (86 Stat. 1311)
>
> Bryce Canyon NP was initially established as Utah National Park to be managed "...subject to the provisions of the Act of August 25, 1916, entitled "An Act to establish a National Park Service, and for other purposes." ..." (43 Stat. 593)
>
> The Act of August 25, 1916 states that parks under the administration of the National Park Service shall be managed "...by such means and measures as conforms to the fundamental purpose of the said parks, monuments, and reservations, which purpose is to conserve the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations." (39 Stat. 535)

The Lake Powell Recreational Area (within 20 miles of Fourmile Bench) and Bryce Canyon National Park (within 30 miles), and Capitol Reef National Park (within 60 miles) are three components of the National Park system presently being studied by the National Park Service and EPA to determine whether or not to recommend reclassificaton from Class II to Class I areas. If these components were to be redesignated as a Class I area, it is possible that Kaiparowits power plant emissions would cause the Class I allowable incremental increases to be exceeded. Such a condition would make the proposed site and the present scope of the power

plant unacceptable. Should such a redesignation be made, additional evaluation of the projected air quality levels and their impact would be necessary with careful consideration of meteorological conditions and persistence and corresponding plume transport. The objective of the NPS-EPA study presently being conducted includes the assembly of the rather limited meteorological data which is available for input into a diffusion model to better define the potential impacts on the three parks. The addition of fine particulates and the conversion of sulfur and nitrogen oxides to aerosols would result in reduced visibility, the amount of reduction dependent upon meteorological conditions.

Periodic yellow-brown atmospheric discoloration from NO_x emissions would be produced. The intensity and extent of the discoloration would be proportional to the concentration of NO_2 in the atmosphere and existing meteorological conditions.

Small amounts of trace elements would be released and accumulated in the ecosystem over the life of the plant. Mercury accumulation in Lake Powell is estimated to be between a minimum of 1 and a maximum of 27 percent of the total added annually by natural sources, depending on the mercury concentration in coal and watershed movement.

Fugitive dusts would be generated periodically from construction activities and exposed soil surfaces. Impacts on aesthetics and visibility would be unavoidable, and inversely proportional to control success.

The impact of steam plume, fogging and icing from the cooling tower water vapor would be unavoidable but localized. Salt dispersion of 1,812 tons per year would adversely impact soils and vegetation in the vicinity of the cooling towers.

Additional air pollution from the expected 14,000 population increase would also be unavoidable and could be potentially significant. An estimated 980

tons of particulates and 700 tons of SO_2 per year could be added to the atmosphere by activities of the new residents.

Most of the adverse impacts discussed in Chapter III for the transmission system could not be mitigated. They are air pollution from accidental fires, ozone production from conductors, noise from conductors, construction noise on the right-of-way, electrostatic effects of the lines and pollutants exhausted from construction equipment and workers' vehicles.

Most of the construction-caused fugitive dust could be controlled by the proposed mitigating measures. Only a small amount would enter the atmosphere. Also the mitigating measures would prevent odd-hour work schedules and avoid locating marshalling areas, camps, and assembly areas near inhabitated areas.

Within the limestone quarry impact area it would be impossible to control dust at all times by water sprinkling or other dust suppression operations. Fugitive dust would enter the air during drilling, blasting and excavating. During dry weather, truck haulage along unpaved roads and in the quarry would result in some fugitive dust between sprinkling truck runs. Dust would accumulate on vegetation along the roadsides between precipitation periods and would be aesthetically displeasing; however, it should not have any significant adverse effects on man, animal, or plants.

Pollutant emissions from internal combustion engines could be only partially controlled by pollution control devices.

Geology and topography

Project modification of topographic features and drainage patterns in the Kaiparowits Plateau impact area would be unavoidable. Major excavations, waste disposal areas, and parts of some structures would remain permanently on about 1,800 acres.

A minimum of about 420 million tons of coal would be removed. An estimated equal amount of coal would be left behind and lost to ultimate recovery. Depletion of this 840 million tons of nonrenewable coal resource would be unavoidable. This represents approximately 10.5 percent of the total known coal reserve on the Kaiparowits Plateau.

The four coal mines would affect an area about 9 by 7 miles (63 square miles). Subsidence of 5 to 10 feet would likely occur over most of the area above mined-out coal beds. Percolation of surface water through these mined areas could contaminate aquifers. Such percolation and contamination would be an unavoidable adverse impact.

Construction of the generating station on Fourmile Bench would defer development of approximately 92 million tons of coal below the station site in order to protect surface installations from subsidence during the life of the plant.

An unknown volume of sand and gravel underlying East Clark Bench would be lost during the life of the town should it be constructed at this location.

For any one of the transmission system proposals most of the adverse impacts to topography could not be mitigated. Two acres would be mined for sand and gravel materials. Access road construction in rough terrain would modify a few hundred acres. Construction of tower sites would permanently modify 12 to 13 acres, while construction of crane pads would temporarily modify 42 to 47 acres, depending upon the proposal chosen.

Even though mined-out areas in the limestone quarry impact area would be filled with waste material, graded and revegetated, the original topography of the ridges would be permanently altered by excavation. A pit 30 feet deep and covering 130 acres would be created.

Soils

An estimated 7,320 acres of soil within the Kaiparowits Plateau impact area would be covered by man-made structures during the life of the project. An additional 1,375 acres would be subjected to an increase in salinity caused by salt drift from cooling towers. Vegetative cover on this acreage would be reduced by up to 70 percent after 50 years of power plant operation.

Trace elements such as arsenic, barium, boron, fluorine, lead, mercury, selenium, titanium, and vanadium contained in the power plant stack emissions would be deposited into the soils within a 30 mile radius of the plant. Fluorine concentrations in the soil would reach 22 ppm after 50 years of power plant operation. Other trace elements would vary from 0.008 ppm for lead to 0.55 ppm for titanium. The concentration of these trace elements in the fly ash-scrubber residue pile would be 20 to thousands of times greater than deposited in the soils. This pile would become a long-term source of pollution to Lake Powell.

In the transmission system impact area, soils disturbance and associated wind and water erosion would increase sediment yield by approximately 28.5 acre-feet annually. Sediment yield would decrease as ground cover is reestablished. However, the soils on about 72 percent of the impact area have low potential for revegetation and recovery would be slow. Of this, about 3,700 acres would be located in an arid or semiarid climatic zone, where lack of moisture severely limits plant growth. Consequently, under normal climatic conditions, ground cover may not be reestablished in some of these areas during the life of the project. The remaining 28 percent would require up to 10 years to reestablish ground cover.

In the limestone quarry impact area, 110 acres would be covered by man-made structures. Productivity would also be reduced on the 130 acre quarry itself. Of the acres in the quarry, 15 to 20 acres of steep side slopes would be subject to severe erosion.

Water resources

Withdrawal and depletion of 50,000 acre-feet per year of water from Lake Powell for the proposed project would make this water unavailable for other uses. Utah's remaining share of Colorado River water would be reduced by about 10 percent. Withdrawal of 50,000 acre-feet annually would result in an estimated net increase in salinity of the Colorado River at Imperial Dam of 2.0 mg/ℓ. This would cause an estimated annual cost damage to lower Colorado River Basin users of about $230,000 in terms of agriculture, municipal and industrial uses.

Application to divert the required 9,690 acre-feet per year of ground water needed for the proposed new town would conflict with existing water rights in the area and with water rights provided by the Colorado River Compact.

Coal mining activities would disrupt perched aquifers that discharge an estimated 160 acre-feet per year of water to seeps and springs in Warm and Last Chance Creeks which are used by wildlife and livestock. The flow of some of the seeps and springs would be depleted by this action. Subsequent subsidence would result in rock fracturing that would create hydraulic connections between fresh- and saline-water aquifers and, thus, generally degrade the quality of ground water in the coal-lease area. This would eliminate or reduce productivity of the area for livestock and some species of wildlife.

Seepage losses from the evaporation ponds (which would contain brines) would be reduced to about 22 acre-feet per year by use of mudstone linings in those ponds. This would have negligible effect on ground-water quality regionally, but could seriously degrade the quality of water in underlying perched aquifers of limited extent and storage capacity which support the flow of seeps and springs used by livestock and wildlife. These seepage losses could also emerge as saline seeps along walls of nearby canyons and eventually enter Warm Creek.

By the end of the proposed project, the fly ash-scrubber sludge residue pile would contain an estimated 50 million cubic yards of ash and scrubber sludge

with concentrations of toxic trace element. The tailings ponds would contain an estimated 43 million cubic yards of tailings with concentrations of pyritic sulfur and toxic trace elements. The evaporation ponds would contain an estimated 160,000 tons of salt. These large stock piles of project-produced wastes would all be in the Warm Creek drainage basin. They would be a long-term source of pollution to the quality of water in Lake Powell and the Colorado River as there would be no incentive to maintain the retaining structures after abandonment.

Smoke stack emissions from the power plant would release some trace elements to the hydrologic system. Some of the mercury that would be deposited in the local drainage basins immediately tributary to Lake Powell would be carried by runoff into the lake and would increase the amount of mercury available for bioamplification in the lake. It could adversely effect the ecosystem in the lake and degrade sport fishing.

For the transmission system, water use for construction processes and dust control would require about 121 acre feet. Most of the adverse impacts on the water resource could be mitigated with the exception of accidental spills of waste materials. Prompt clean up of these wastes would negate further impact on the resource.

The proposed limestone quarry is in the fully appropriated Sevier River Basin. Application to divert the 2,000 gallons per day of ground water needed to operate the quarry would conflict with existing water rights. Use of this water for operation of the quarry would be at the expense of some existing use. Blasting at the quarry site during the projected 35 years of operation could eventually reduce the flow of Tom Best and Reynolds Springs. This reduction would reduce the available water supply for wildlife, livestock and irrigation proportionately.

Vegetation

Physical improvements in the Kaiparowits Plateau impact area, would cause a permanent loss of about 7,320 acres of native vegetation. Salt drift

from cooling towers would eliminate an estimated 70 percent of the vegetation from about 1,375 additional acres over a period of 50 years. After abandonment another 124 acres would be lost on the side slopes of the fly ash-scrubber residue disposal site due to erosion.

Unavoidable adverse impacts to vegetation in the transmission system impact area would occur along any of the three proposals. There would be approximately 1,573 acres and 75 animal unit months (AUM) lost on a permanent basis in the primary proposal, 1,350 acres and 53 AUM's lost in the Northern Kaiparowits proposal and 1,890 acres and 87 AUM's lost in the Arizona Strip proposal. In addition there would be an unavoidable loss of some protected, rare, endangered or threatened plant species during construction.

In the limestone quarry impact area, the loss of about 110 acres of vegetation due to various facilities and roads would be unavoidable. Vegetation would be lost on an additional 20-30 acres a number of years after abandonment due to erosion on side slopes where quarry rehabilitation could not be maintained.

Wildlife

In the Kaiparowits Plateau impact area, approximately 7,320 acres would be permanently lost to physical development and 1,375 acres reduced in productivity by salt drift. The greatest impact to wildlife would result from the increased activities of the 14,000 new inhabitants. An estimated increase of 13,700 man-days of hunting, 15,000 man-days of fishing, 40,000 man-days of off-road vehicle use, and other outdoor activities would be expected within a 100 mile radius of the residences of the new population.

The existing antelope population probably would be eliminated from East Clark Bench and surrounding area along with any future chances for reestablishment. The probability of desert bighorn becoming reestablished on Fiftymile Mountain would be diminished by increased human activity. The wild bison herd on

the Henry Mountains, already subject to extensive poaching, would suffer increased losses.

An uncertain quantity of mercury could be introduced into Lake Powell where mercury levels in some game fish are already at maximum level considered safe for human consumption. A significant increase of mercury in game fish would seriously reduce value of the sport fishery to man. Accumulations within the fallout area of other toxic elements such as selenium and arsenic would cause a potential long-term hazard to terrestrial and aquatic wildlife.

The transmission system impact area under any of the three proposals would cause permanent disturbance to habitat on 1,350 to 1,890 acres. Productivity for most wildlife would be lowered by habitat alteration. Upland game birds and small mammals may benefit from invasion of subclimax vegetation on disturbed areas, whereas migratory birds would suffer from reduction of riparian vegetation.

On the primary proposal, the greatest adverse impact on wildlife would result from increased poaching and disturbance induced by approximately 1,900 miles of roads (870 permanent) into areas previously remote from human activity. The other two proposals would require 1,765 and 2,085 miles of roads, with 735 and 1,055 miles, respectively, being permanent.

Construction and maintenance of the transmission system would cause unavoidable adverse impacts on wildlife and wildlife habitat, even with diligent implementation of proposed mitigating measures. Alteration of soil and vegetation would affect the ability of the ecosystem to support existing wildlife species. Some recovery of the habitat would be expected with time, but habitat in fragile arid areas may never fully recover.

Increased access provided by construction of 1,900 miles of new roads into areas previously remote from human activity would have adverse secondary impacts on wildlife resources that would be unavoidable and significant. There would be increased legal hunting; and poaching, harassment of wildlife, killing of raptors, and collecting of unique species such as the desert tortoise.

Desert bighorn sheep would be unavoidably impacted by removal of existing forage along the proposed transmission system. The climate, topography and soil in most desert bighorn range makes revegetation difficult. Additional human disturbance in the form of increased contact, hunting and poaching would place additional stress on this species that requires relative isolation from human interference.

During the construction phase, daily and seasonal movements of animals might be blocked or interrupted. The more mobile species would probably not suffer appreciably but smaller animals with small home ranges would be adversely affected. Small animals may die if blocked from important parts of their habitat.

Proposed transmission corridors would adversely impact habitats occupied by the following endangered species: black-footed ferret, brown pelican, southern bald eagle, peregrine falcon, Vegas Valley leopard frog, moapa dace, woundfin, Colorado River squawfish, Gila topminnow, humpback chub, bonytail chub, Colorado cutthroat trout, and possibly other, as yet unidentified species.

Adverse impacts would result from outright killing of individuals during construction and maintenance activities and/or alteration, reduction, and loss of habitat. However, local impacts would be of greater consequence to the species as a whole because of already reduced numbers or range. Most of these species have become diminished in numbers or range either because critical features of their habitat are already in short supply, or because they are especially vulnerable to man's activities. Therefore, alteration of a relatively small area of critical habitat or introduction of increased human activity could be a significant increment to an already adverse environment.

The impact of a wildlife species becoming extinct would be irreversible and permanent. That particular gene pool would be permanently lost as would future opportunities for scientific study of that species and whatever knowledge this might benefit man's understanding of his environment.

In the limestone quarry impact area, diversified wildlife include a few wintering deer and elk which would be eliminated from about 240 acres. Hazards to a nearby colony of Utah prairie dogs, an endangered species, would be increased by road construction, traffic and human activity. Some wildlife would be reduced over a larger area if nearby springs are eliminated by the quarrying operation.

Ecological interrelationships

Clearing vegetation in the Kaiparowits Plateau impact area from 7,320 acres of land and covering it with an impervious surface would eliminate forage for livestock and wildlife. Most vegetation would be eliminated from an additional 1,375 acres over a 50 year period by salt accumulation from cooling tower drift. A major portion of the salt drift loss would be in a pinyon-juniper stand averaging 500 to 700 years old. Populations of deer and other wildlife associated with this vegetative type would be lost and livestock grazing eliminated.

Coal mine operation would cause springs and seeps to dry up, a loss of water source for livestock and wildlife. Saline and fresh water aquifiers would also become mixed.

Human activity resulting from new town establishment would also create erosion problems, plus increased sediment deposition in Lake Powell through recreational activities. Also, human recreational activities could interfere with nesting and reproduction of birds of prey.

Surface disturbances and vegetation removal in the transmission system impact area would set plant communities back to earlier stages of plant succession, increase erosion, reduce soil moisture, and physically damage animals and their dens, shelters, cavities and nests. Desert vegetative types would be very slow to recover. Recovery may take 20 to 50 years and on some harsh, extreme sites revegetation would perhaps not occur. Changes in vegetation would be followed by

corresponding changes in wildlife because of their dependency on vegetative types.

In the limestone quarry impact area, vegetation would be lost from 110 acres. Another 15 to 20 acres probably could not be revegetated due to erosion on the quarry side slopes after abandonment has taken place. This situation would result in a loss of forage for wildlife. The removal of vegetation would increase competition for forage and place an added burden on undisturbed plant communities at least until some of the vegetation is reestablished.

Increased human activity would be the major unavoidable impact on ecological interrelationships in the area. Hunting pressure and harassment of wildlife would be increased and habitats of some animals would be altered in avoiding the presence of man.

Paleontology, archaeology and history

Paleontological, archaeological and historical resources in the Kaiparowits Plateau impact area would be disturbed or destroyed. Direct impacts would be controlled to the maximum possible extent by mitigating measures, such as survey, salvage and relocation operations, but these would not eliminate damage to the non-renewable unique scientific resource base. Elimination of nine or ten archaeological sites in the areas of the power generating station and coal mine would be unavoidable. Limitations in existing technology for location, evaluation, recovery, and analysis would prevent total data preservation and remove those sites affected from future research use when technology is expected to be better.

Paleontological, archaeological, historical and cultural resources in the transmission system impact area would be disturbed or destroyed. Direct impacts would be controlled to the maximum possible extent by mitigating measures, but these would not eliminate damage to the non-renewable, unique, scientific resource base. Limitations in existing technology for location, evaluation,

recovery, and analysis would prevent total data preservation and remove those sites affected from future research use when technology is expected to be better.

For the most part, archaeological resources in the transmission system impact area are as yet unidentified, and unassessed for preservation values. Many of the known sites appear to be eligible for inclusion in the National Register of Historic Places. Several archaeological and historical sites, districts, and trails along the proposed transmission system are presently nominated to or included in the National Register.

Removal of archaeological or historical artifacts from their natural setting in the limestone quarry impact area would be unavoidable in areas to be developed or quarried. Significant data would not be destroyed if proper survey and salvage were conducted prior to disturbance. However, even with mitigation, sites or parts of sites would be unavoidably damaged or destroyed.

In all areas indirect impacts would stem from improved access and increased human activity. Both accidental and intentional activities would erode the resource base. Disturbance or destruction by unauthorized collectors, vandals, and recreational users would occur. These losses would be uncontrollable.

Recreation

Natural values on a 7,320 acre area would be destroyed, including a portion of the mature pinyon-juniper forest on Fourmile Bench. The natural environment at Grosvenor Arch will be disturbed by the new highway. All adjacent areas having primitive values would be impacted by destructive effects associated with increased human and vehicle use.

Potentially the most severe impact would be the effect that haze and sky discoloration emitted from the stacks would have on the quality experience of the millions of people who annually visit the nationally important parks and scenic areas in the region, including Bryce Canyon National Park and Glen Canyon National Recreation Area.

The structures and landscape modifications associated with the proposed plant and mining complex would have a high visual impact on the travelers along the proposed new highway. The proposed marshalling yard, construction camp and new town site in the East Clark Bench area would also institute a high visual impact.

The increase in the number of people participating in outdoor recreation would result in the need for additional marina facilities at Lake Powell, destruction of cultural and natural values in a 30,000 square mile area are due to increased off-road vehicle use, and reduced deer hunting success due to overhunting.

There would be noise and congestion problems along the proposed new highway due to increased truck and commuter traffic.

The major impact of the proposed transmission system would be the unavoidable adverse visual effects. Regardless of the number of mitigating measures applied, the system would still create a major intrusion into otherwise natural landscapes.

Thirty recreation areas would be directly or indirectly impacted by the intrusion of the proposed transmission system. The system would also intrude upon hundreds of miles of landscape with high scenic values.

Approximately 1,900 miles of new permanent and temporary roads would increase access and open up otherwise remote areas. The use of these roads could cause increased soil erosion, wildlife disturbance, off-road vehicle damage, vegetation loss and could introduce an undetermined number of recreationalists into the transmission area.

The proposed transmission system would occupy approximately 3,000 acres of base recreation lands. The construction and maintenance activities of the transmission system could tend to degrade the quality of the outdoor recreation experience for the users of the area.

The transmission system would cross and be visual from numerous highways. The impact would be dependent on the number of viewers of the transmission system and their ideas and attitudes toward the intrusions created by the transmission system. Along the entire transmission system it is estimated that a daily average of 320,000 travelers could view the lines and roads.

Proposed actions at the limestone quarry impact area would remove 240 acres from recreational use. Dust from blasting and crushing operations would have moderate visual impact. The 30 round trip truck hauls per day originating at the quarry would create traffic congestion and safety problems along the Johns Valley road and through the northeast corner of Bryce Canyon National Park, particularly during the summer tourist months.

Land use

In the Kaiparowits Plateau impact area, livestock forage that could support 780 animal unit months (AUM's) in the generating stations and mining areas and 450 AUM's at the new town site would be lost. This loss would have an adverse economic impact on the affected operators. They could be forced to reduce the size of their herds or even quit the livestock business.

Mining of non-coal mineral resources would be restricted in all occupied or developed areas. Oil and gas drilling would be restricted on at least 6,468 acres in the generating station, coal mine, and new town areas.

Increased traffic and the transport of heavy loads would unavoidably damage roads. Maintenance and patrolling would require capital expenditures exceeding current expenses, and may not be entirely offset by the participants pre-payment of taxes.

Several adverse impacts could not be mitigated for the proposed transmission system. In western California, Las Vegas, Nevada, and northwestern

Arizona the proposed transmission lines would infringe upon recreational and residential lands. These lands may suffer a loss in value due to the presence of the transmission lines. Two existing air strips would have to be closed because the transmission lines would interfere with their glide path. The development of a proposed major airport in Eldorado Valley, Nevada, would be precluded. Livestock grazing in the impact area would be reduced by 75 animal unit months annually. Fifty-eight acres of agricultural land would be permanently lost in Riverside County, California. In the limestone quarry impact area, livestock grazing would be excluded from 240 acres during the life of the project. About 130 of these acres would be reclaimed, leaving 110 acres that would not be reclaimed and would be unavailable for grazing for many years.

Socioeconomic factors

Two adverse impacts in the Kaiparowits Plateau impact area would be loss of a "sense of community" and changes in present community organization. These have resulted from similar projects in the past.

By 1985 an estimated 2,354 basic employees would reside in the proposed new town and about 785 in Page, Arizona. Timely implementation of the companies' community plans would prevent a boom town situation. Delays in implementing the plan, or a low quality town as a result, would tend to shift much of the population and its impacts to Page, Arizona. Assuming new town development goes according to plan, trailer facilities would house much of the population. Trailer housing is often thought of as "temporary," but its nature makes many people in the trailer villages feel that they are not really part of the community.

Regardless of the success in planning, some discomfort and inconvenience would be expected. Planning for the industrial development to attract employees is far ahead of planning for the service and housing needs that would be created by

the development. Water and sewer inadequacy are often critical concerns; additional population would create new water needs, and existing water facilities are inadequate from an environmental health standpoint. Also, many social impacts could not be mitigated because hospitals, mental health facilities, and other facilities do not yet exist in the area.

Though new job opportunities would be created, potential economic benefits to present local residents would not be realized. Due to lack of local skilled personnel, a high percentage of the employees would be trained migrants. This and other factors could create tension between present residents who attempt to maintain existing sociological patterns and the trained migrants whose socio-economic and political interests would differ from those of the present community.

Political base-line changes could be expected that could result in a large block of voters in the new town controlling local and regional destinies. This change in community organization would be a direct result of population influx.

The limestone quarry impact area would be subject to the same kinds of impacts as described for the plateau region, with perhaps some modifications due to the distance between the quarry and the planned power plant and the town. With no plan for routing heavy truck traffic from the limestone quarry around the small towns in Garfield County, no mass transportation plans, and heavy traffic expected, a disrupting influence on communities may be expected.

In transmission line impact areas, basic impacts would be temporary use of lodging and service facilities by construction workers, erection of power lines across land which some Indians may wish to keep pristine, and to supporters of a non-growth ethic, a belief that their life style is being threatened.

Market area

Impacts in the market area in southern California and Arizona are discussed in detail in Chapter III. Increased concern about air pollution, mass

transit, open space preservation and planning may mitigate adverse impacts to a degree. The quality of community life in the market area will probably deteriorate due to the positive relationship between continued urban growth and availability of electricity. None of this impact can be directly attributed to Kaiparowits, but only to the overall increase in available electricity.

INTRODUCTION

All impacts that would be caused by the proposed project are set out in Chapter III. Chapter IV describes measures that would reduce, or eliminate, some of those impacts. This chapter contains an analysis of the adverse impacts that would remain after the mitigation described in Chapter IV. In other words, these are unavoidable adverse impacts. It is important to remember that if the mitigating measures are not carried out, or are unsuccessful, then the unavoidable adverse impacts will be as described in Chapter III, rather than in Chapter V.

CLIMATE

No significant impacts on climate have yet been measured in the Southwest as a result of emissions from large coal-fired power plants and no significant impacts on climate would be expected from the Kaiparowits power plant or associated transmission system.

The effluent plume from the proposed Kaiparowits generating plant could exceed air quality Class I limitations of closer areas (with potential for Class I designation) such as Bryce Canyon National Park and Glen Canyon National Recreation Area. Calculations supporting this statement are only preliminary and careful consideration would have to be given to meteorological conditions, persistence, and corresponding plume transport if reclassification of these areas occurred.

AIR QUALITY

Kaiparowits Plateau impact area

Emission control devices planned for the proposed Kaiparowits plant would be designed to remove major amounts of sulfur dioxide (SO_2) (90%) and particulates (99.5%); and amounts of other elements including phosphorous, selenium, arsenic, mercury and fluorides associated in varying amounts with ash. The boiler is proposed to be designed to control the release of nitrogen oxides (NO_x) within emission standards. Materials that are removed would then appear in the bottom ash, fly ash, and scrubber waste. The balance would be emitted to the atmosphere. Figure V-1 identifies the amount of particulates, SO_2, and NO_x that would be emitted into the atmosphere with average and worst grade coal.

FIGURE V-1

Emission Rates

	Emission[a]					
	Average Grade Coal			Worst Grade Coal		
	Particulate	SO_2	NO_x	Particulate	SO_2	NO_x
Tons per hour[b]	.43	1.15	10.42	.58	2.17	10.42
Tons per year[c]	2,820	7,555	68,000			

[a]90 percent control of SO_2; 99.5 percent control of particulates; and 32.5 percent control of NO_x.

[b]100 percent load factor.

[c]75 percent load factor.

These emission levels are equal to or below federal and state standards, but do represent some unavoidable degradation of existing air quality.

As discussed in Chapter III, it is not unreasonable to expect that 99.5 percent particulate removal with virtually 100 percent availability would be feasible at the time the Kaiparowits power plant is completed. Electrostatic precipitators (ESP) on units 4 and 5 at the Four Corners plant were designed for 97 percent efficiency and have performed at 97 and 98 percent efficiency, respectively. The experience at the San Juan power plant with ESP's has been good. The Navajo power plant's compliance testing efficiency was 99.6 percent with design efficiency of 99.5 percent. Under normal operation the efficiency has been 99.1 percent. The cold side electrostatic precipitator at Huntington has been meeting 99.5 percent efficiency. Experience with SO_2 scrubbing is more limited but recent studies at the Mohave plant have shown that 90 percent efficiency would be feasible at Kaiparowits with full time coverage. The Cholla coal-fired power plant in Arizona is presently achieving approximately 90 percent efficiency with 90 percent availability using a two module venturi and limestone scrubber.

Particulate control required to meet the limitations of the Class II area designation of the Prevention of Significant Deterioration Regulations would be 98.8 percent removal based on the Intercomp diffusion model and 99.1 percent removal, based on the National Oceanic and Atmospheric Administration (NOAA) model. Emission rates of particulates would be 1.40 and 1.05 tons per hour respectively, at the above removal rates, compared with 0.58 ton per hour with proposed control.

Sulfur dioxide control required to meet the limitations of the Class II area designation of the Prevention of Significant Deterioration Regulations would be 77.8 percent removal based on the Intercomp model and 82.8 percent based on the NOAA model. Emission rates of sulfur dioxide would be 4.79 and 3.72 tons per hour, respectively, compared with 2.17 tons per hour with proposed control.

The proposed site at Fourmile Bench lies within a 100-mile radius of a number of National Parks, National Recreation Areas, National Monuments, and National Forests, all of which have the potential for redesignation to a Class I area in which practically any change in air quality would be considered significant. The National Park Service (1976) feels that the operation of the Kaiparowits plant would result in air quality impacts that are adverse to the legislative purpose of Glen Canyon National Recreation Area and Bryce Canyon National Park. The relevant extracts from the appropriate legislation are as follows:

> Glen Canyon NRA was established "...in order...to preserve scenic...features contributing to public enjoyment of the area..." (86 Stat. 1311)
>
> Bryce Canyon NP was initially established as Utah National Park to be managed "...subject to the provisions of the Act of August 25, 1916, entitled "An Act to establish a National Park Service, and for other purposes." ..." (43 Stat. 593)
>
> The Act of August 25, 1916 states that parks under the administration of the National Park Service shall be managed "...by such means and measures as conforms to the fundamental purpose of the said parks, monuments, and reservations, which purpose is to conserve the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations." (39 Stat. 535)

The Lake Powell Recreational Area (within 20 miles of Fourmile Bench) and Bryce Canyon National Park (within 30 miles), and Capitol Reef National Park (within 60 miles) are three components of the National Park system presently being studied by the National Park Service and EPA to determine whether or not to recommend reclassification from Class II to Class I areas. If these components were to be redesignated as a Class I area, it is possible that Kaiparowits power plant emissions would cause the Class I allowable incremental increases to be exceeded. Such a condition would make the proposed site and the present scope of the power plant unacceptable. Should such a redesignation be made, additional evaluation of the projected air quality levels and their impact would be necessary with

careful consideration of meteorological conditions and persistence and corresponding plume transport. The objective of the NPS-EPA study presently being conducted includes the assembly of the rather limited meteorological data which is available for input into a diffusion model to better define the potential impacts on the three parks.

The emission of fine particulates and conversion of sulfur and nitrogen oxides to aerosols would cause a visibility reduction that could not be mitigated. The relationships between emissions, atmospheric particulate concentrations and visibility effects are not completely defined. Predicted reductions in visibility were made (Bechtel, 1974) considering locations which would affect relatively large numbers of people. According to the study, the visual range of a person located at Page, Arizona, looking northward along the plume axis would be reduced from 70 miles to 51 miles, or a reduction of approximately 25 percent. From the same view point, visibility looking toward the south along the plume axis would be reduced from 70 miles to 61 miles or 13 percent. Visibility reduction in other directions would be insignificant. For a person at Grand Canyon, looking north along the plume axis, the reduction in visibility would be from 70 miles to 57 miles or approximately 20 percent. Visibility reductions along other lines of sight would be insignificant. These predictions are based on meteorological conditions including north and northeast winds estimated to occur about 5 percent of the time. More frequent visibility reductions would be expected to the north and east of the site because prevailing winds would carry the plume in that direction. The visibility study considered neutral atmospheric conditions as such conditions occur with high frequency. Meteorological conditions that would be more restrictive to dispersion such as stable conditions, limited mixing or stagnation conditions would occur less frequently but could have a greater impact on visibility. Lower emission control efficiency or an unlikely complete failure of an emission control system could significantly reduce visibility. Actual

observation of the Navajo plume shows the plume to be visible from cross section although the effect of the plume on visibility has not yet been measured or documented.

Visibility in the immediate vicinity of the power plant could be reduced by cooling tower plume and evaporation pond effects. During cold, humid conditions, an elevated plume may rise to nearly 3,000 feet above ground and extend 2 miles downwind. A visible plume would be expected to occur about 97 percent of the time, but half of the time it would evaporate before reaching 180 feet in length. Elevated tower plume lengths in excess of 1,000 feet would occur about 10 percent of the time, and lengths in excess of 1 mile about 0.3 percent of the time. Ground fogging at 1,000 feet downwind from the towers would likely occur about 8 percent of the time (30 days per year) and less than 0.2 percent of the time (one day per year) at a downwind distance of 1 mile. Due to plant location and size of the plant area adverse visibility effect from the cooling towers would be limited to the immediate plant area. Because of remoteness, few people except workers would be affected by the periodic reduction in visibility. Dissolved salts in entrained water droplets would be carried downwind from the cooling towers. This would result in an estimated dispersal of approximately 1,812 tons of salt per year which would adversely impact soils and vegetation within a limited area.

Failure of the particulate removal systems could release as much as 117 tons per hour of particulates to the atmosphere if worst grade coal were being used at 100 percent load. The chance of simultaneous failure of all four units, however, would be remote; and if it occurred, it would be short-term in duration because of enforceable emission limitations. If such a failure did occur, the immediate impact would be on aesthetics by a far more opaque plume with its great potential visibility reduction.

Failure of the SO_2 scrubber system could release approximately 22 tons of SO_2 per hour to the atmosphere when burning worst grade coal at 100 percent

load factor. Pilot studies of the proposed scrubber conducted at Mohave (discussed in Chapter III) have shown such a failure would be remote. Complete SO_2 release while using worst grade coal would exceed emission limitations and could exceed ambient air concentration limitations under some meteorological conditions. Such conditions would exceed limitations considered necessary to protect human health and welfare and could approach air concentration levels in some areas which, when combined with predicted NO_x levels, would be in the range of possible injury to vegetation.

Nitrogen dioxides released during coal combustion would produce a periodic yellow-brown discoloration proportional to the nitrogen dioxide concentration. This could contribute to overall degradation of visual environment. Studies by Bechtel Power Corporation (1974) have indicated the brown discoloration would usually not be noticeable unless the observer was looking along the plume axis. However, the plume at Navajo is quite noticeable from any angle. During low wind speed, neutral to slightly stable conditions, the Navajo plume can be tracked visually because of the apparent brown color, having first become visible during the operation of the first unit and deepening with two units. Because the proposed control measures for NO_x are similar for Kaiparowits, incidence of brown haze from nitrogen dioxide could become commonplace in the area.

The coal that would be burned contains small amounts of trace elements and radionuclides, some of which would be released to the atmosphere during operating life of the plant. Although emission levels and ground level concentration of these elements is predicted to be low, and within or below measured ambient air levels, pathways through the ecosystem of many of the elements are not well defined. Long-term accumulations must be considered. Recent studies on mercury in the Lake Powell region (Standiford, et al., 1973) have pointed out potential for increases in mercury levels in various components of the ecosystem from power plant emissions. Mercury contribution to the Lake Powell ecosystem would depend upon the mercury concentration in the coal, the amount released from

the plant, the deposition rate on the watershed and lake, and the rate of movement of watershed deposited mercury into the lake. It is estimated that the contribution of mercury into Lake Powell would be between 16 and 480 pounds per year or 1 to 27 percent of that contributed from natural sources.

Auto exhausts are primary sources of hydrocarbons and carbon monoxide. Exhausts from cars transporting approximately 300 plant operating personnel and 700 mining personnel entering or leaving the plant and mine areas during shift change would add to existing levels of these pollutants. These emissions would be supplemented by other vehicular activity used to haul limestone, oil, fly ash etc. These emissions, when considered singularly, would be diluted to low levels very soon after release, but as a group would unavoidably add to existing background levels.

The mining, transportation and conversion of coal would require a large labor force. This labor force and their families would need storekeepers, teachers, doctors, and others who would supply supporting services. Activities of these people would degrade local air quality. The expected Kaiparowits area population increase would be approximately 14,000 by the tenth year of development. The pollution generated by this population increase, including contribution from transportation, solid waste disposal, residential and commercial fuel consumption and miscellaneous sources, is estimated to include 980 tons of particulates and 700 tons of SO_2 per year. The particulate emissions represent approximately 35 percent of the annual particulate emissions from the generating station. Additional particulate burdens could be expected as the result of soil surface disturbance, both short- and long-term from off-road recreational activities associated with the population increase. The SO_2 additions would be a smaller percentage of the total generating station output but do add to the air quality burden.

Transmission system impact area

General

Major adverse impacts were identified in Chapter III:

1. During construction and the line stringing operation there would be considerable degradation of air quality from fugitive dust.

2. There is possibility of severe local air quality degradation from combustion products if vegetative materials accumulated during line clearing operations would be accidentally burned. This special problem could only occur in national forests or in a few areas of dense woodland on national resource lands. If wood chipping machines are used promptly as debris occurs, there would be no problem.

3. Ozone production would occur only when the proposed power lines are energized. Ozone production is variable depending on voltage, elevation, weather conditions, type and size of conductors. However, tests conducted under the worst possible conditions using 765 kV lines showed that ozone production was far below adverse levels (Scherer, 1973, Frydman, 1973). This and other studies indicate ozone production impact would be insignificant along this entire route.

4. Noise and electrical interferences are additional adverse impacts that occur when transmission lines are energized. Corona discharges along the transmission system would be very near ambient sound levels, 30-50 decibels (db). This impact also would be insignificant. Even during inclement weather such as rain or snow, when noise levels from corona discharge increase 10-20 db, this level would still be well within reasonable limits.

A temporary noise impact near cities and towns close to the proposed transmission lines would not be mitigated. This would be a minor impact along most of the route, but would be of some significance in Bullhead City, Arizona; North Palm Springs, and Romoland, California where substations are located and where construction activities might be more disturbing.

Helicopter noise could be a disturbing impact near cities and towns along the route, but with suggested mitigating measures the residual impact would be insignificant.

Along with ozone production and noise, corona discharge produces radio and television interference. Since this effect is relative to receiver distance from the source (transmission lines) and to the strength and direction of incoming radio signals, significant impacts would occur only in cities and towns within a few miles of the proposed right-of-way. Most radio interference would occur in the AM broadcast band and television interference on channels 2-6, (VHF low load where signal strength is low). This may require large, more specialized antennas to overcome this interference. Overall, this impact would be small.

Another impact that occurs when transmission lines are energized is an electrostatic effect that induces a discharge from the transmission lines to an ungrounded object near the lines. This is similar to the effect of static electricity when a person walks across a nylon carpet and touches a metal doorknob. This could cause some discomfort at times but would not be a significant impact. The suggested mitigation measures should eliminate a major portion of the problem.

There are no indications that transmission lines at the 500 kV level would result in induced voltages harmful to plants or animals, including humans, under and around the transmission lines. However, studies are still being made as to the effects on humans who are constantly exposed to this and higher levels of exposure at generating plants and substations.

Specific impacts

Kaiparowits to Phoenix

Air quality impacts would come from dust generated by roads, tower sites, and work areas, plus automotive pollutants along the proposed route.

The only mitigation would be watering to keep down the dust.

Kaiparowits to Navajo

Air quality impacts and automotive pollutants would degrade air quality along the proposed route. Due to high air quality and temporary nature of the activity, the residual impact in this area would be insignificant.

Kaiparowits to Eldorado

Air quality could be degraded because of construction dust, and pollutants from various automotive equipment, helicopters and stationary machines used during the construction process. At some points such as Moapa and Henderson, Nevada, pollutants added by the proposed construction would have a cumulative impact on an existing air shed with local pollution sources (coalfired generating plant at Moapa and a steam plant near Henderson). Overall, air quality impacts along this route would be insignificant due to good to excellent existing air quality and the brief nature of the impact. However, in the portion of the route from Henderson, Nevada to Eldorado substation, any additional pollutants could further impact an air shed, already being degraded by industrial operators and a growing population.

Kaiparowits to Moenkopi to Mohave

Air quality would be degraded by dust and automotive pollutants in construction areas. Because air quality is good to excellent along the route, only one site indicated a significant impact possibility. This is where the route would come close to Kingman, Arizona, and the Mohave generating plant. If construction work is closely monitored here and construction sites are kept watered, impacts on air quality from dust pollution should be insignificant.

Slash accumulation in the Tusayon District of the Kaibab National Forest could create severe air pollution if fire were accidentally started. The smoke and other gases would be visible near Grand Canyon and along Arizona State

Highway 154. If proper mitigation measures are followed such as chipping, there should be no significant impact on air quality along this route.

Mohave to Serrano

This portion of the proposed transmission line route is best discussed by breaking it into subsegments as in previous chapters:

Any additional particulate pollution in this area would be detrimental to the air standards.

1. The Mohave Desert subsegment in California would mostly use existing access roads. Only required stub roads and tower sites would need construction. All towers would be guyed and thus overall additional residual impact on air quality in this subsegment should be insignificant mostly because existing roads would be used.

2. The Coachella Valley subsegment portion of the route is very sensitive to air quality degradation because of two existing air pollution problems. There is a strong influx of contaminated air from the Los Angeles Basin. This air pollution stems primarily from automotive engines and is carried by westerly winds into the Coachella Valley area that includes Palm Springs, Indio, and several other desert resort cities. Strong inversion conditions frequently hold these pollutants in the valley. Additional automotive-caused pollution comes from Interstate Route 10 which traverses the valley from east to west. Also, strong westerly winds contribute to a serious blowing sand problem that occurs in the Banning Pass area, just west of Palm Springs. Winds up to 100 miles per hour have been measured in the pass, and house trailers, campers etc., are turned over and windshields often sandblasted during sandstorms. The few miles of new roads needed are in the eastern portion of Coachella Valley. New roads would also be used by off-road vehicles, causing a small secondary impact

on air quality. Any construction activity through this valley would add some cumulative damage to existing conditions described in Chapter II.

3. The valley subsegment would go from Devers substation on the west end of Coachella Valley to Serrano substation just outside the city of Orange in Orange County.

Automotive and stationary engine exhausts would add to already serious air pollution in this area. Mitigation by sprinkling would take place as the proposed route nears cities and towns such as Cabazon and Romoland, but overall effects on air quality would be felt by local citizens. Any addition to the summer air pollution problem would be cumulative.

Impacts from off-road vehicles should not be a problem here since most land is private and the Cleveland National Forest portion of the route would be closed to traffic once the transmission system is in operation.

Northern Kaiparowits to Mohave preferred alternate

This proposed route is comparable to the Kaiparowits to Eldorado route. The residual impacts of the Northern Kaiparowits to Mohave preferred alternate on air quality would be insignificant.

Arizona Strip preferred alternate

This route is much the same as the Northern Kaiparowits to Mohave preferred alternate in terms of new roads needed and ambient air quality. This route would also traverse a remote area away from towns or cities through an area with excellent air quality. This route would go through 40-50 miles of dense woodland, and there would be a heavy accumulation of slash. An accidental fire in this area would create a heavy layer of smoke and gases between Las Vegas and the Arizona-Utah border. This route would have insignificant impacts on air quality.

Limestone quarry impact area

It would be impossible to control dust at all times by water sprinkling or other dust suppression operations. Fugitive dust would enter the air during drilling, blasting and excavating. During dry weather, truck haulage along unpaved roads and in the quarry would result in some fugitive dust between sprinkling truck runs. Dust would accumulate on vegetation along the roadsides between precipitation periods and would be aesthetically displeasing; however, it should not have any significant adverse effects on man, animal, or plants.

Pollutant emissions from internal combustion engines could be only partially controlled by pollution control devices.

GEOLOGY AND TOPOGRAPHY

Kaiparowits Plateau impact area

Modification of topographic features and drainage patterns from project construction and operation activities would be unavoidable. Although mitigation calls for restoration of the project area to generally conform with pre-project topography, an exact duplication would be impossible. Major excavations, the ash-sludge disposal area, the coarse refuse dump, and parts or all of some structures would remain permanently. The exact acreage upon which topography would be unavoidably changed is not known, but it would exceed 1,800 acres.

During the proposed 35-year life of the project, a minimum of about 420 million tons of coal would be mined and consumed. Because of technological limitations associated with underground coal mining, an estimated equal amount of coal would be left behind and lost to ultimate recovery. The loss of this quantity of a nonrenewable resource would be an unavoidable adverse impact.

By the use of high recovery mining techniques, "trough" subsidence ranging from about 5 to 10 feet would likely occur over a major portion of the coal mine area. The resultant surface depressions could enhance the accumulation and subsequent percolation of surface water into underlying strata. Possible contamination of existing aquifers from these surface waters passing through other formations and mined out-voids would be an unavoidable adverse impact.

In addition to coal that would be unmined due to technological limitations or a requirement for overlying surface protection, an estimated 92 million tons of coal in beds 4 feet thick or thicker are present beneath the proposed 4,160-acre generation station site. Should the generation station be constructed on Fourmile Bench, development of this coal reserve would be deferred during the life of the generating facility in order to protect surface installations from subsidence. Utah has very large coal reserves and only a portion of these are

expected to be mined in the next 30 to 50 years (the life of the generating plant); therefore, deferring removal of this coal would be adverse only during this period of time. Actually deferring recovery of this coal for 3 to 5 decades might help to recover a larger percentage of the resource through advanced mining technology expected by that time.

The new town and new highway would not drastically affect topographic features, other than surface disturbance during construction.

Transmission system impact area (primary, Arizona Strip, and Northern Kaiparowits to Mohave proposals)

Use of sand and gravel for concrete along any of the proposed routes would modify about 2 acres of topography. After rehabilitation, the sites would remain as small, bowl-shaped depressions.

A few hundred acres of topography in rough terrain could be modified by construction of access roads for any one of the proposals. Except for the proposed Kaiparowits to Phoenix route, which is to be rehabilitated and closed, modifications from access roads would be permanent.

Construction of tower sites and crane pads would also modify topography in areas of rough terrain. Total acres modified by tower sites would range from 12 to 13 acres on any of the proposals and the total for crane pads would range from 42 to 47 acres. Modifications would be permanent at tower sites and temporary at crane pads.

Limestone quarry impact area

Even though mined-out areas would be partially back filled with waste material, then graded and revegetated, the original topography would be permanently altered by excavation. Removal of 8.3 million tons of limestone and 4.5 million

tons of waste material over the 35-year life of the project would reduce elevation of approximately 130 acres by about 30 feet. Not only would this be an impact on topography, but likewise a sizable impact on geology through removal of large quantities of constituent formations from the property.

SOILS

Kaiparowits Plateau impact area

Unavoidable adverse effects on soils would result in the loss of productivity on 7,320 acres after mitigation due either to the physical occupation by man-made facilities or the inability to rehabilitate. This acreage also includes the 450 acres that would be utilized for disposal of fly ash and scrubber sludge.

Figure V-2 depicts the acres that would be disturbed, rehabilitated and no longer in its original state due to implementation of the project.

FIGURE V-2

Acreages Involved in Action
for Kaiparowits Plateau

Action	Acres Disturbed	Acres Reclaimed After Construction	Acres Not Reclaimed and No Longer in Original State
Power plant	1,172	240	932
Water pipe line	620	395	225
Access highway	405	125	280
Coal mine	1,841	192	1,649
New town	5,000	1,100	3,900
Aggregate sites	420	88	332
Total	9,460	2,140	7,320

After a lapse of 50 years, an additional 1,375 acres would be subjected to salt drift from cooling towers resulting in an estimated 70 percent reduction in vegetative cover. At this time the soil electrical conductivity would equal

or exceed 4 millimhos (EC x 10^3) which is considered injurious to sagebrush, pinyon and juniper (Bernstein, 1958; Gates, et al, 1956; Richards, 1954). The remaining 30 percent of the vegetative cover would consist of grasses and forbs that are tolerant up to an electrical conductivity level of 12 millimhos (EC x 10^3).

After mitigation of the project the estimated annual runoff and sediment into Warm Creek Drainage, Wahweap Creek Drainage, Lake Powell and the Paria River would change as follows:

Drainage	Increased Acre-Feet of Runoff	Percent Increase over Present Estimates	Change in Acre-Feet of Sediment	Percent Change over Present Estimates
Warm Creek	20.2	2.0	-1.2	-1.0
Wahweap Creek	31.9 to 51.9	1.6 to 2.6	+0.3	+0.1
Lake Powell	52.1 to 72.1	1.7 to 2.4	-0.9	-0.2
Paria River	1.65	0.01	-0.01	-0-

Figure V-3 identifies the estimated effects of the proposed project on Lake Powell and the Paria River.

FIGURE V-3

Estimated Effect of Project on Annual Acre-Feet of Runoff and Sediment Deposition into Lake Powell and the Paria River

Site Affected	Present Estimates (acre-feet)	Effects of Construction During (acre-feet)	Effects of Construction After (acre-feet)	Amount Mitigated (acre-feet)	Final Estimates (acre-feet)
Lake Powell					
Runoff	3,000	3,013	3,060 to 3,080	7.9	3,052.1 to 3,072.1
Sediment	385	386.9	384.5	0.4	384.1
Paria River					
Runoff	21,600	21,600.7	21,601.95	0.3	21,601.65
Sediment	846	846.02	846.01	0.01	846

When comparing the final estimates of runoff and sediment to present estimates the change would be less than 3 percent and 1 percent, respectively, and probably therefore of no significance.

In addition to the loss of productivity on the unreclaimed lands, the readily identifiable adverse impact would be the creation of the 450 acre fly ash-scrubber sludge disposal site, which would be 70 feet high after 35 years. This site could be a source of trace element pollution to the water courses and Lake Powell after the topsoil cover on the side slopes has eroded off. This erosion would occur after abandonment of the project when maintenance is no longer practiced on the site.

Also trace elements such as arsenic, barium, boron, fluorine, lead, mercury, selenium, titanium and vanadium contained in the power plant stack emissions would be deposited into the soils within a 30 mile radius of the plant. Fluorine concentrations in the soil would reach 22 parts per million (ppm) after 50 years of plant operation. Other trace elements would vary from 0.008 ppm for lead to 0.55 ppm for titanium.

<u>Transmission system impact area</u>

Between 1,350 and 1,890 acres (depending on the proposal), would be permanently occupied by structures and roads.

Soil loss during the construction period and prior to establishment of adequate vegetative ground cover could not be avoided. Even with mitigation, a soil loss of approximately 28.5 acre-feet the first year of the proposed project would occur. As ground cover is reestablished, soil loss would decline by an unquantifiable amount. The rehabilitation potential for disturbed areas along the proposed project is figured for three classes. They are:

Low	Less than 20 percent
Medium	20 to 50 percent
High	More than 50 percent

These classes were rated on the basis of annual precipitation, evapotranspiration rate and soils. The above percentages relate to the possibility of seedling establishment in any one growing season.

The rehabilitation potential for the three proposals would be as follows:

Percent	Primary Proposal (acres)	Northern Kaiparowits Proposal (acres)	Arizona Strip Proposal (acres)
Less than 20	5,306	4,957	6,253
20 - 50	1,769	1,652	2,084
More than 50	295	276	348
Total	7,370	6,885	8,685

Approximately 6,600 acres within each of the three proposed routes have a low rehabilitation potential. This means the potential for reestablishing ground cover would be less than one chance in five, any one year, making quantification highly speculative.

Approximately 370 acres of each of the proposals have a 50 percent chance of reestablishment in any one year. Much of the Sonoran and Mohave deserts are covered with desert pavement. Disturbance of this pavement, such as by the proposed action, could cause scars that would take hundreds of years to heal.

Approximately 3,700 acres of the transmission system would be in arid to semiarid climatic zones. These areas would be slow to recover, requiring perhaps 50 years or more.

Above average moisture years would accelerate the recovery period over the entire system, but under normal circumstances 3,700 acres of the system would not completely recover during life of the proposed project. Assuming that the uppermost layers of soil are the most valuable to plant growth the soil loss would result in a permanent loss of vegetative productivity.

<u>Limestone quarry impact area</u>

Unavoidable adverse effects on soils would result in the loss of productivity on 110 acres due to the physical occupation by man-made facilities.

Figure V-4 depicts the acreages involved in the limestone quarry that would be disturbed, reclaimed and no longer in their original state.

FIGURE V-4

Acreages Involved in Action
for Limestone Quarry

Action	Acres Disturbed	Acres Reclaimed after Abandonment	Acres not Reclaimed and no Longer in Original State
Limestone quarry	240	130	110

Topsoil can be placed on the 130 acres of quarry and revegetated; however, the productivity of this landscaped surface may be lower than the original surface. Revegetation on the side slopes may not be able to take place until the slopes have stabilized by erosional processes. If the topsoil is eroded off the side slopes of the quarry and washed to the bottom then revegetation would not occur on 15 to 20 acres of the quarry area, which would be in addition to the 110 acres already identified.

Figure V-5 identifies the estimated effect of the proposed limestone quarry on Piute Reservoir.

FIGURE V-5

Estimated Effect of Action on Annual Acre-Feet of Runoff and Sediment Deposition into Piute Reservoir

Site Affected	Present Estimates (acre-feet)	Effects of Construction During (acre-feet)	Effects of Construction After (acre-feet)	Amount Mitigated (acre-feet)	Final Estimates (acre-feet)
Piute Res.[a]					
Runoff	--	0.4	2.1	1.0	1.1
Sediment	0.13	0.18	0.1	--	0.08

[a]This represents the limestone quarry site and the estimates pertain only to that site and not the drainage system, which was the case in the Lake Powell and Paria River Analysis.

After abandonment and mitigation the estimated annual runoff in Piute Reservoir would be 1.1 acre-feet greater than present estimates, which is less than 1 percent and considered insignificant. The sediment yield would be 0.05 acre-foot less than present estimates, which would pose no problem to the fisheries in Piute Reservoir.

The adverse impacts would consist of 110 acres no longer being productive and an additional 20 to 30 acres a number of years after abandonment and maintenance of the reclaimed side slopes is no longer practiced.

WATER RESOURCES

Kaiparowits Plateau impact area

Withdrawal of 50,000 acre-feet of water per year from Lake Powell for the proposed project would make the water unavailable for other uses and would reduce Utah's remaining share of Colorado River water by about 10 percent.

The withdrawal and depletion of this 50,000 acre-feet per year would also result in a net increase in salinity of the Colorado River at Imperial Dam by an estimated 2.0 milligrams per liter (mg/ℓ). An increase in salinity of one mg/ℓ in the Colorado River (as measured at Imperial Dam) could result in an annual cost damage to Lower Colorado River water users of an estimated $230,000 when expressed in terms of agricultural, municipal and industrial uses. The increased salinity resulting from the proposed project would be offset by various projects of the Colorado River Water Quality Improvement Program, but cost would have to be passed on to that program (which is financed by Federal funds and revenue from hydroelectric power generation).

Figure V-6 identifies the unavoidable adverse impacts to water resources should the project be built. Application to divert 9,690 acre-feet of ground water per year for the proposed new town on East Clark Bench would conflict with existing ground water rights, and with water rights provided by the Colorado River Compact. This could result in lengthy and costly legal proceedings to resolve the water-right problems.

Coal mining activities associated with the proposed project would disrupt perched aquifers that discharge an estimated 160 acre-feet of water per year to seeps and springs used by wildlife and livestock in Warm and Last Chance Creeks. Blasting, excavation and mine drainage over the projected 35-year life of the proposed project would dewater some of these aquifers and deplete the flow of some springs. Subsequent subsidence and associated rock fracturing would

FIGURE V-6

Estimated Impacts on Various Water-Resources From Proposed Kaiparowits Power Project

Impact Area	Present Conditions	Effect of the Project	Amount Mitigated	Net Effect of Project
Utahs remaining share of Colorado River Water	495,000 acre-ft/yr	Depletion of 50,000 acre-ft/yr or approx 10 percent	None	Depletion of 50,000 acre-ft/yr or approx 10 percent
Colorado River Salinity at Imperial Dam	Average approx 878 mg/ℓ	Increase of 2.0 mg/ℓ	[a]---	Increase of 2.0 mg/ℓ
Ground water recharge in Kaiparowits impact area	30,000 acre-ft/yr	Decrease of about 34 acre-ft/yr or 0.1 percent	None	Decrease of about 34 acre-ft/yr or 0.1 percent
Ground water withdrawal in East Clark Bench area	500 acre-ft/yr	Increase of about 9,690 acre-ft/yr	None	Increase of about 9,690 acre-ft/yr
Ground water withdrawals in limestone quarry	None	Increase of 2,000 gal/day or approx 2 acre-ft/yr	None	Increase of 2,000 gal/day or approx 2 acre-ft/yr
Ground water quality	Fresh to slightly saline	[b]---	[b]---	[b]---
Perched aquifers in coal lease area	Discharge estimated 160 acre-ft/yr of fresh to slightly saline water	Decreased discharge and degraded water quality	[c]---	Decreased discharged and degraded quality

[a]Net increase is based on withdrawal and depletion of 50,000 acre-feet per year of water from Lake Powell under 1972 conditions. Increase would not be mitigated but would be offset by various projects under the Colorado River Water Quality Improvement program which was implemented to control salinity in the Colorado River while development to use appropriated water continues.

[b]Adverse effects on ground water quality would be local and cannot be qualified. The proposed mitigating measure would eliminate or greatly reduce these effects.

[c]Because water (some saline) produced by the mines would be used and not allowed to reach Lake Powell, impact on quality of water in the lake would be beneficial, but unmeasureable.

create hydraulic connection between fresh and saline water aquifers and generally degrade ground water quality in the coal-lease area. The result would be displacement of some wildlife and reduction of the livestock grazing range.

The principal source of construction aggregate for the proposed project would be alluvium in Upper Wahweap Creek. The alluvium forms part of a local aquifer. Recoverable ground water storage capacity of the aquifer would be reduced an estimated 200 acre-feet by removal of this alluvium. The operation would increase evaporation losses of the ground water locally, but the effect on downstream water users would be too small to evaluate.

Construction of the generating station and related facilities on Fourmile Bench would reduce natural ground water recharge by an estimated 34 acre-feet per year. This would cause a near equal reduction of natural ground water discharge, that occurs mostly as evapotranspiration in the canyons that drain Fourmile Bench. The reduction of natural ground water discharge would be too small to measure, and the effects would be too small to evaluate.

Evaporation ponds would receive cooling tower blowdown water having a dissolved solids concentration of about 7,500 mg/ℓ along with other mineralized effluents. These fluids would eventually be concentrated to brines as a result of evaporation and would be a potential long-term source of contaminants for underlying ground water.

The 2-foot thick layer of mudstone that would line the evaporation ponds would reduce maximum seepage losses from those ponds to about 22 acre-feet per year. These small losses would have a negligible impact on ground-water quality regionally. However, they could seriously degrade the quality of ground water in a local perched aquifer (such as that which supports the flow of Wesses Spring) because those individual aquifers apparently do not contain much more than 22 acre-feet of water in transient storage. Seepage losses from the evaporation

ponds could also emerge as saline seeps along walls of nearby canyons and eventually enter Warm Creek. The potential for contamination of ground water by seepage from the evaporation ponds would not end after completion of the proposed project. Eventually the ponds would be dry; wind erosion could then expose the mudstone lining causing it to dry out and crack much like the bottom of a dry lake. Precipitation falling in the ponds could then dissolve accumulated salt and carry it through cracks in the mudstone to the permeable underlying sandstone. From there the contaminants could eventually seep to an underlying aquifer.

The tailings pond associated with the proposed coal mine would also present a long-term potential for ground water contamination. However, this potential would be less pronounced because tailings: (1) would be more viscous and therefore less apt to penetrate the mudstone lining; (2) would contain fluids with a much lower dissolved solids concentration; and (3) would have a large water retaining capacity because of their fine-grained composition. These tailings, though, would contain trace elements that would eventually enter the ground water system in potentially toxic concentrations and, in a diluted form, eventually reach seeps and springs used by livestock and wildlife.

Although a number of water conserving practices (including recycling) would be used in the proposed project, an estimated 300 acre-feet of water per year would be lost by seepage from the water-storage reservoir at the generating station. Assuming there is an average annual natural evaporation rate of 5 feet in the Kaiparowits Plateau impact area, at least 300 more acre-feet per year of water would be lost by evaporation from the reservoir and other components of the water supply system. During the projected 35-year life a total of 1,750,000 acre-feet of water would be used and a total of 21,000 acre-feet would be lost to evaporation.

By the end of the projected 35-year life of the proposed project, the ash disposal area would cover about 450 acres and contain an estimated 50 million

cubic yards of ash and scrubber sludge with concentrations of toxic trace elements. Also, the tailings pond would cover about 550 acres and contain an estimated 43 million cubic yards of tailings with concentrations of pyritic sulfur and toxic trace elements. The evaporation ponds would cover an additional 180 acres and contain an estimated 160,000 tons of salt. All these facilities would be in Warm Creek drainage. The ash disposal area would be rehabilitated, but complete success of the proposed rehabilitation is questionable (see soils section); also, since there are no required mitigation measures to insure maintenance, it is possible that none of the facilities would be maintained after the proposed project has been completed. Consequently, the large stockpiles of concentrated trace elements and other salts would be a long-term source of contaminants that would effect water quality in Lake Powell (especially in Warm Creek Bay) and the Colorado River. The retention structures would be constructed to last indefinitely. Never the less, the same elements that carved the deep canyons leading from the Kaiparowits Plateau would still be operative to breach those structures and release the pollutants. It is possible that uniform long-term erosion and runoff would carry the trace elements and salts to the lake in nontoxic concentrations. However, considering that the project area is prone to cloudburst floods and associated rapid erosion, each succeeding flood could carry large amounts of contaminants from these facilities to the lake. The concentrations would be harmful to the lake ecosystem and down stream water users.

Drift loss from cooling towers would deposit an estimated 1,812 tons of salt per year within Warm and Wahweap Creek drainage basins. This would increase the annual salt load of these creeks by about 10 tons, but any effect on aquatic life in Lake Powell would be too small to evaluate.

The stack emissions from the proposed generating station would release some trace elements into the hydrologic system. Some of the mercury deposited in

the local drainage basins immediately tributary to Lake Powell would be carried by runoff into the lake. This would increase the amount of mercury available for bio-amplification in the lake, and could adversely affect sport fishing and the lake ecosystem. Long-term deposition of nitrogen oxides from stack emissions directly on Lake Powell, especially in shallow inlets, could promote algae blooms. However, there are insufficient data from which to evaluate this possibility.

Transmission system impact area

primary, Arizona Strip, and Northern Kaiparowits to Mohave proposals

Accidental spills of waste material would probably be the only source of water pollution resulting from construction of the proposed transmission system. Such spills would have an effect on water quality if they occurred in or near a perennial stream. However, prompt cleanup, as required by mitigating measures, would minimize the amount of material reaching the stream and the duration of the pollution event. Such small amounts of material would cause slight declines in water quality which would in time be reversed or neutralized by the natural processes of dissipation and biodegradation. Approximately 121 acre-feet of water would be unavoidably lost by use during the project.

Limestone quarry impact area

Application to appropriate 2,000 gallons of water per day from a well at the proposed quarry site could conflict with existing water rights because the quarry would be located in a fully appropriated river basin where issuance of permits for additional ground water is restricted. Use of this water at the quarry would be at the expense of some existing use.

Blasting at the quarry site during the projected 35-year life of the proposed project could eventually reduce the flow of Tom Best and Reynolds Springs

which are within 1 mile of the quarry area and discharge from the same rock formation that would be quarried. Reduction in spring flow would reduce the available water supply for wildlife, livestock, and irrigation, proportionately.

VEGETATION

Kaiparowits Plateau impact area

The generating station, water pipe line, access highway, coal mine, new community, aggregate site and access roads would result in a permanent loss of approximately 7,320 acres of native vegetation in the Kaiparowits Plateau impact area. A portion of the vegetation represents the natural climax or permanent pinyon-juniper woodland which is potentially a source of unique scientific information. Identified threatened and endangered plant species occur in the impact area. An indeterminable number of individual plants on the threatened and endangered species list would be lost if site surveys (see Chapter III) were not completed. The projected large influx of people and their associated business and recreational activities could severely damage vegetation in many areas, particularly on the more fragile habitats. Although difficult to quantify, this could reasonably be expected to be of greater impact than removal of vegetation by construction activities. In areas subject to cooling tower salt drift deposition, a loss of the less salt tolerant plant species on 1,375 acres would be unavoidable. An estimated 70 percent of the vegetative cover would be lost over the 1,375 acres.

No effects on vegetation are expected from the calculated emission levels of sulfur dioxide and nitrogen oxides.

The degree to which mercury released from the proposed power plant would move into the lake and the rate at which it would accumulate in aquatic vegetation is not well documented. Although the expected addition would be a small proportion of that provided by natural sources, it would nevertheless represent an addition to the present levels.

After abandonment another 124 acres would be lost due to erosion on the side slopes of the fly ash-scrubber residue disposal site.

Transmission system impact area

Construction of the proposed transmission line would disturb vegetative cover, cause loss of livestock/wildlife forage and cause loss of protected, rare, endangered and threatened plant species. Construction of new roads into previously undisturbed areas would increase off-road vehicle travel that would indirectly increase vegetative disturbance.

There would be unavoidable adverse vegetative impacts that would occur on a temporary basis, until vegetation could be gradually reestablished on these areas. There would be an estimated 8,945 total acres disturbed and 431 animal unit months (AUM) lost to construction of the primary proposal; 8,235 acres disturbed and 363 AUM's on the Northern Kaiparowits proposal and 10,575 acres and 503 AUM's on the Arizona Strip proposal. These figures would gradually be reduced over a period of several years to a point where only those areas permanently occupied by improvements would be lost. It is estimated that the desert areas would require 10 to 30 years to recover, whereas the areas receiving more moisture could require up to 10 years.

Figure V-7 indicates unmitigated adverse impacts of vegetative disturbance on acres permanently taken out of production, and AUM's of potential livestock/wildlife forage permanently lost annually. These data are based on assumptions that over a period of years, vegetative cover would return to a near natural stage on areas not permanently occupied. However, with good rehabilitation success and protection during seedling establishment, some of this loss in AUM's could be retrieved. The variables affecting this make it impossible to quantify.

Figure V-7 indicates from a vegetative standpoint, the Northern Kaiparowits proposal would have the least adverse impact in acres permanently taken out of production and AUM's lost, and the Arizona Strip proposal would be most adversely impacted.

FIGURE V-7

Unmitigated Adverse Effects on Vegetation

Vegetative Communities	Primary Proposal			Northern Kaiparowits Proposal			Arizona Strip Proposal		
	Miles of Corridor	Perm. Occupied Acres	[a]AUMs Lost Annually	Miles of Corridor	Perm. Occupied Acres	[a]AUMs Lost Annually	Miles of Corridor	Perm. Occupied Acres	[a]AUMs Lost Annually
Pinyon-Juniper Woodland	221	240	10	164	113	5	216	308	13
Great Basin Desert Scrub	300	356	12	289	273	9	225	270	9
Plains & Desert Grasslands	158	199	25	86	56	7	134	210	26
Mohave Desert Scrub	529	595	20	652	689	23	604	872	29
Riparian (Woodland)	7	5	1	5	1	--	5	1	--
Chaparral (Interior)	17	2	--	17	2	--	17	2	--
Sonoran Desert Scrub	45	5	--	45	5	--	45	5	--
Coastal Sage Scrub	6	5	--	6	5	--	6	5	--
Urban - Agriculture	58	44	--	58	44	--	58	44	--
Joshua Tree Woodland	26	56	4	64	94	6	40	105	7
Chaparral (Coastal)	90	68	3	90	68	3	90	68	3
Totals	1,457	1,575	75	1,476	1,350	53	1,440	1,890	87

[a]AUMs lost annually refers to those AUMs lost to permanently occupied acres.

For acres lost per AUM for each proposal refer to Chapter III, Figures III-29 through III-31.

Within the Navajo Indian Reservation, estimated unavoidable adverse impacts on vegetation would be as follows:

Primary proposal:	1,440 acres disturbed and 50 AUM's lost, of which 185 acres and 6 AUM's would be permanently lost.
Northern Kaiparowits and Arizona Strip proposals:	893 acres disturbed and 32 AUM's lost, of which 11 acres and 1 AUM would be permanently lost.

There would be an unknown unavoidable loss of protected, rare, endangered and threatened plant species during construction. These species often have low populations and removal of a few individual plants may significantly affect the entire population. Other protected species, such as some of the Cactaceae (cactus) family, have large populations and would be less adversely impacted if a few individual plants were removed.

The protected, rare, endangered or threatened plant species would be affected by either direct removal or by changing of the site through soil disturbance and compaction. If the sites are changed significantly, they may no longer be capable of supporting these species. There would be an unavoidable adverse loss of some protected, rare, endangered, and threatened plant species for scientific value and study unless they are salvaged. Quantification would not be possible until detailed, site specific inventories of the occurrence of these species were compared with a detailed, on-the-ground location of transmission facilities. These data are not now available.

Limestone quarry impact area

The removal, covering, or other disturbance of approximately 240 acres of vegetation by the quarry operation and associated facilities is unavoidable if the quarry is developed. The ponderosa pine stand is not a highly productive site with good capabilities for sustained commercial production. Expected changes in the site due to quarry operation would further lower site quality resulting in a permanent loss of the ponderosa pine community. Several unique plant species occur in the area such as western bristlecone, dwarf sagebrush, Panguitch buckwheat, Jones oxytrope and low daisy. Panguitch buckwheat is classified as a threatened species under the Endangered Species Act of 1973.

WILDLIFE

Kaiparowits Plateau impact area

Essentially all adverse impacts on fish and wildlife discussed in Chapter III would be unavoidable should the project be constructed. Several statutory authorities provide legal basis for mitigation of fish and wildlife losses under certain conditions. However, from a practical standpoint, opportunities for mitigation measures would be limited for wildlife within the Kaiparowits Plateau impact area. Some examples of the problem are given below.

Major adverse impacts would result from secondary effects of increased human population and outdoor activity. Little could be done to mitigate this impact.

Installation of a screening device to prevent fish losses at the water intake in Lake Powell, which could legally be required under the Fish and Wildlife Coordination Act, is probably not feasible. Therefore, some periodic loss of fish at the water intake would be unavoidable.

The only known feasible way of mitigating loss of wildlife habitat is to increase the carrying capacity of another area nearby. The climate, soil, topography, and land use patterns of the Kaiparowits Plateau make it difficult to increase productivity of any remaining areas sufficiently to offset lost productivity of eliminated habitat.

The town site would be in the heart of the only antelope range in this portion of Utah. Therefore, there would be no practical way to mitigate this loss. Even if the town were located elsewhere increased human activity and unplanned development on East Clark Bench would have much the same effect on antelope. Loss of potential for reestablishing an antelope population would be unavoidable.

The "Bald Eagle Protection Act" may deter some new residents from wanton killing of eagles by authorizing a $5,000 fine and imprisonment. However, it does not provide any additional law enforcement to apprehend violators.

Unavoidable adverse impacts to fish and wildlife within the Kaiparowits Plateau impact area, and secondary impacts on wildlife of surrounding terrain are summarized below.

Approximately 7,320 acres of habitat of various types and levels of productivity would be permanently and totally eliminated by structural features of the plant, mine, water line, highway, and new town. An additional 1,375 acres would be drastically altered over a period of 50 years by cumulative salt drifts from cooling towers. Included in this total loss would be pinyon-juniper woodland capable of supporting about 30 mule deer year-round and 90 seasonally. About 3,900 acres of the permanent loss at the new town site would be open range land and scattered pinyon-juniper in the center of an area of historic antelope habitat where a number of antelope have been released in an attempt to reestablish a herd. The proposal would almost certainly eliminate any possibility of successful reestablishment in the area.

There would be danger that mercury discharged by the Kaiparowits project, added to the naturally high mercury load of the Colorado River, and mercury from the nearby existing Navajo generating plant, could jeopardize sport fishing of Lake Powell by mercury contamination in game fish. Mercury would be accumulated and retained in sediments at the bottom of Lake Powell and would remain a potential hazard long beyond life of the project.

Long-term accumulations of toxic trace elements would be a largely unavoidable potential future hazard to all wildlife and their habitat, including invertebrates and microorganisms.

When the water level in Lake Powell is low, periodic loss of fish into the water line intake would probably be unavoidable.

Outdoor activities of an estimated 14,000 new inhabitants in a now sparsely populated area would have more widespread adverse impact on most wildlife resources than would physical features of the project. An estimated increase of 13,700 man-days of hunting, 15,000 man-days of fishing, and 40,000 man-days of off-road vehicle use could be expected within a 100-mile radius of the new town site. Increased legal hunting, poaching, harassment, and inadvertent disturbance would reduce populations of some wildlife species. Particularly vulnerable would be the bison herd on the Henry Mountains, wild turkeys on Boulder Mountain, antelope on East Clark Bench, and large raptors throughout the area. Probability for successful reestablishment of bighorn sheep on Fiftymile Mountain would be reduced.

High aesthetic value of back-country type trout fishing in high mountain lakes of Boulder Mountain and the Aquarius Plateau would unavoidably be lowered by increased human use.

Transmission system impact area

General overview

Even with diligent implementation of proposed mitigating measures, construction and maintenance of the transmission system would cause residual or unavoidable adverse impacts.

In spite of efforts to minimize disturbance, the construction of roads, towers, pulling sites, storage facilities and communication sites would disturb wildlife and wildlife habitat, and this temporary disturbance could not be avoided. Alteration of soil and vegetation would affect the ability of the ecosystem to support existing wildlife species. The result would be displacement of some wildlife species and an invasion of the altered area by others.

Depending upon capacity of disturbed areas to return through succession to the existing ecosystem, the time period required to restore an area might be from 5 to 10 years on areas of riparian or chaparral habitat to from 50 to 100 years on arid lands of the Mohave and Sonoran deserts.

Unavoidable adverse impacts of disturbance or destruction of vegetation would be:

1. For a period of 5 to 10 years in wet or high moisture areas and from 50 to 100 years in arid areas, depending upon climatic condition, wildlife habitat would be destroyed at tower sites, crane pads, assembly areas, pulling sites, road system, and communication sites.

   a. For the permanent road system, wildlife habitat would be completely destroyed by removal of vegetation, compaction and consequent increased aridity of soil.

   b. For the temporary road system, wildlife habitat and the present natural condition would be destroyed or altered so that most areas may return to the present environmental condition in 5 to 10 years. However, in arid areas, the present environmental condition may not return for 50 to 100 years.

These unavoidable changes would result in adjustments in wildlife populations, especially those small animals with home ranges of 0.5 acres. Populations of species dependent upon secondary successional vegetation would increase. Populations dependent upon climax vegetation would decrease. Unavoidable secondary impacts would result in alteration in species composition of wildlife populations available for observation, hunting, or study by man in these areas.

2. Elimination of wildlife species dependent upon existing habitat. These would be displaced if the existing habitat were destroyed. Displaced individuals would probably not inhabit adjacent territories because these territories would be occupied by other individuals of the same species; therefore, these displaced individuals would likely perish.

3. In the Mohave and Sonoran deserts, where habitat would be eliminated by clearing, animal populations may never return to existing levels. Many of these animals have adapted to extreme desert conditions. Generally, the environmental key to wildlife existence in these areas is vegetation that provides cover, food, and in some cases moisture. Conditions to which these specialized plants have adapted are so severe that when soil and water flow patterns are disturbed by vegetational clearing, revegetation may require decades if it occurs at all. Without reestablishment of plants, animal populations would not return to normal along the desert portion of the power line.

4. Revegetation of disturbed areas would not duplicate conditions prior to destruction of existing vegetation and soil structure. Therefore, wildlife species invading the areas would be different from populations previously inhabiting the areas.

Unavoidable adverse impacts of increased human access would be:

1. Increased access where effective closure of access roads to the public could not be accomplished. Wildlife populations would be adversely affected by increased legal and illegal hunting, fishing, and collecting; and by harassment of game and nongame populations.

2. Increased and improved access into areas that would remain open to the public. Wildlife populations in these areas would be adversely affected by increased legal and illegal hunting, fishing, and collecting; and by harassment of game and nongame populations.

3. Increased collecting of unique, endangered, threatened, protected and national interest wildlife species that would be more readily available because of improved and increased access. These species are highly prized by man.

4. Increased illegal killing of raptors would result from increased human access. Perching raptors make a fairly easy target when perching atop towers.

Unavoidable adverse impacts of physical damage caused by construction would be as follows:

1. During construction, most mobile animals would leave areas along the proposed route prior to habitat destruction. However, species with limited mobility would likely be crushed and either killed or injured. Loss of these individuals would cause a reduction in local populations, but the species would would likely recover.

2. Crushing and killing of wildlife species with limited mobility, by vehicles using access roads.

Specific impacts

Big game

Primary proposal

Unavoidable adverse impacts of the primary proposal on big game would be as follows:

1. The elk population may decrease less than 5 percent.

2. Although the participants would be prevented from disturbing mule deer, antelope and elk during crucial stress times of the year, such as fawning and winter survival, access resulting from construction would allow disturbance by the public in crucial areas on the Beaver Dam Mountains, near Williams, and on Black Mesa, Perry Mesa and Sycamore Mesa.

3. Access resulting from construction would allow the disturbance and interference with desert bighorn sheep migration north and east of the Black Hills.

4. Creating and improving access into primary crucial desert bighorn sheep habitat would reduce the quality an estimated 50 percent for indigenous desert bighorn sheep - a national interest species - on the east side of the East Mormon Range, the south side of the Mormon Range, the east side of Dry Lake Range, the west side of the River Mountains, the west side of the Black Hills south of Railroad Pass, and the east side of the McCullough Range (all in Nevada) and the roadless areas of the Coxcomb Mountains in southern California.

Northern Kaiparowits proposal

For mule deer, antelope, and elk the same unavoidable adverse impacts as the primary proposal would apply; however, an additional 9 acres would be permanently disturbed and 13 acres would be temporarily disturbed on the Beaver Dam Mountains. There would be an estimated 60 percent increase in disturbance of the most critical mule deer winter range along the transmission line in northern Arizona. This would reduce deer numbers until revegetation took place.

For desert bighorn sheep, the same unavoidable adverse impacts as discussed above would occur. Initial access into undisturbed or restricted areas would be the primary adverse impact. An additional mountain range, the Highland Range, would be opened to public use.

Arizona Strip proposal

Unavoidable adverse impacts on big game would be:

1. Loss of an additional 310 acres of pinyon-juniper habitat type along 24 miles east of the Virgin Mountains. Based on a carrying capacity of 10 acres per AUM and 4 mule deer per AUM, this calculates to loss of about 10 mule deer. Also, increased access into some of the best trophy mule deer hunting areas in Arizona and the western United States would make it easier to poach deer in this area.

2. Loss of a remote area for potential desert bighorn sheep reintroduction in the Virgin Mountains. The loss to desert bighorn sheep in the Highland Range would be the same as the Northern Kaiparowits proposal.

For white-tail deer, peccary and mountain lion, unavoidable adverse impacts (all proposals) would be caused by alteration of their habitat, increased access into their habitat, and loss by increased poaching and hunting, similar to those discussed above.

Unavoidable adverse impacts on upland game birds and waterfowl on all proposals would be as follows:

1. Upland game birds and waterfowl in all areas would still collide with unlighted conductors, towers, and static lines. The number of birds killed or maimed by this type of collision cannot be quantified but would likely be small.

2. There is no guarantee that workmen employed by participant contractor would not cause damage to riparian habitat. Also, because of increased access along the proposed route, there would be additional impacts to riparian habitat by public use of the road system and riparian areas.

3. Crucial Gambel's quail habitat in Cedar Wash would remain in its present ecological state, and be virtually 100 percent mitigated by restricting access. However, poaching and destruction of Gambel's quail and its habitat in other areas would not be reduced.

4. For other upland game birds, subclimax stages of vegetation would invade disturbed areas thus increasing habitat for these birds. However, if successful rehabilitation projects are completed, subclimax vegetation required for survival of these species would be eliminated. Reduction in population of these species along the proposed route would be directly and inversely related to success of rehabilitation projects.

Nongame species (all proposals)

Inventory and identification of crucial wildlife habitat would only delineate crucial habitat for some species, but probably not crucial habitat for all animal species. Therefore, crucial habitat for some species, possibly an endangered or unique species, would not be identified and protected. The result would be possible loss of the species in its native habitat.

Raptors

Primary and Northern Kaiparowits proposals

Unavoidable adverse impacts would be as follows.

1. Inventory and identification of crucial wildlife habitat would probably not be 100 percent effective and not all crucial habitat for raptors would be identified. This would likely result in unquantifiable losses.

2. Even though access roads would be approximately 2 miles from an active nest, peregrine and prairie falcons are highly desired by falconers and nests would possibly be found and eggs and young removed. Increased or improved access into the area would further endanger these species.

3. Raptors in these areas would collide with unlighted conductors, towers, and static lines. Number of raptors killed or maimed by this type of collision cannot be predicted.

4. Since raptors prefer high perches, they would utilize the towers. Because of improved or new access roads to these towers, perching raptors would be vulnerable to increased shooting.

5. Even though the transmission line would be constructed through Cedar Wash by helicopter and no access road would be constructed, access would be improved to the head and base of Cedar Wash. This would allow falconers and the public into this densely populated raptor area.

Arizona Strip proposal

The Virgin Mountains, because of diversified multilevel vegetation, support large populations of small mammals that in turn support a high raptor population. The same unavoidable adverse impacts described above would also apply to this proposal.

Impacts on threatened or unique species (all proposals)

Mammals

Even though the Stephen's kangaroo rat and black-footed ferret habitat would be inventoried, flagged and protected from disturbance by workmen, the fact that these are endangered or rare wildlife species would increase public visitation to the area. Public use would also be increased by construction or improvement of the road system in the area. Collecting of these species would increase and could not be effectively regulated.

Sufficient information is not known about the spotted bat along the proposed route. Consequently, impacts on this species cannot be analyzed.

Birds

Brown pelicans may be killed or injured during migration while flying near transmission lines or towers along the proposed route north of Overton Wildlife Management Area and Lake Mead.

Effects on the southern bald eagle and peregrine falcon would be the same as for other raptors previously discussed.

Amphibians

Even though the Vegas Valley leopard frog habitat would be inventoried, flagged and protected from disturbance by workmen, the fact that they are an endangered wildlife species would increase public visitation to the areas. Public use would also be increased by improvement of the road system in the

area. Collecting of this species would increase and could not be effectively regulated.

Reptiles

Unavoidable adverse impacts on reptiles would be as follows.

1. Even though habitat of these species would be inventoried, flagged and protected from disturbance by workmen, reptiles would be extremely vulnerable to professional and amateur collectors. Therefore, because of increased and improved access, greater numbers of reptiles would be collected, some illegally.

2. During clearing of the right-of-way, numerous slow-moving reptiles along with other animals with limited mobility would be crushed, maimed or killed.

3. Existing materials sites in crucial desert tortoise habitat would be used to extract gravel and other material. Desert tortoise may become trapped in these sites and die.

Fishes

Unavoidable adverse impacts would be as follows.

1. Inventorying and identification of crucial fish habitat would likely not identify location of all species. Likewise, not all crucial habitat for all fish species would be identified. It would be possible that crucial habitat for some species, possibly an endangered or unique species, would not be identified and therefore not protected. The result would be possible partial loss of the species in its native habitat.

2. Even though habitat and population of endangered or protected fishes would be inventoried, identified, and protected from disturbance, the fact that these are endangered wildlife species would perhaps increase public visitations to the area. Public use would also be increased by construction or improvement of the road system in the area. Collecting of these species would increase and could not be completely regulated.

Invertebrates and microorganisms

It is impossible to predict adverse impacts on these organisms.

Limestone quarry impact area

About 240 acres of diversified habitat supporting small populations of a number of wildlife species including an estimated five wintering deer or elk, and occasionally visited by mountain lions would be unavoidably and permanently lost. A nearby colony of Utah prairie dogs, an endangered species, would be subjected to increased hazard from increased traffic and human activity. This increased exposure of the Utah prairie dog population would require increased law enforcement efforts by the Utah Division of Wildlife. This effort would involve patrol of the area by the local conservation officer. Nearby springs and seeps vital to some wildlife of the surrounding area would be jeopardized by watershed alteration and ground water withdrawal. Noise probably would eliminate a few of the more sensitive wildlife species from the immediate vicinity, or reduce their level of productivity.

The losses of animal habitat on the 240 acres and adjacent lands are small in terms of the total Sevier Valley but it is an increment in the diminishing habitat for wildlife as development of wild lands takes place. Diversified wildlife populations of the surrounding area would suffer some indeterminate losses from the disturbance of increased human activity.

Potential hazard to nearby springs and seeps, and dependent populations of wildlife, from watershed alteration would be largely unavoidable.

ECOLOGICAL INTERRELATIONSHIPS

Kaiparowits Plateau impact area

Should the project be implemented, 7,320 acres of vegetation would be covered with either an impervious surface or be incapable of rehabilitation. Livestock and wildlife forage would be reduced accordingly. Also, the power plant would remove a pinyon-juniper stand that averages 500 to 700 years old.

Over a period of 50 years, another 1,375 acres would lose about 70 percent of its vegetative cover due to salt accumulation from cooling tower drift. The deer population as well as small bird and mammal population would suffer from this vegetative reduction. The first vegetative species reduced would be sagebrush and pinyon-juniper trees. Therefore animals associated with this plant community would be lost on these areas. The grazing capacity for livestock would also be reduced 1,230 animal unit months.

Should the coal mine go into operation, the springs and seeps in Drip Tank Canyon could dry up and no longer be available to livestock and wildlife. There is also the possiblility of mixing saline and fresh ground water as mining progresses. The magnitude of this possible impact cannot be quantified at this time, however the limiting effect of water on animal populations in this area would be reflected on adjacent ranges.

Human activity resulting from establishment of a new town would create erosion problems resulting in increased sediment deposition in Lake Powell. Also human recreational activities would interfere with nesting and reproduction of birds of prey. Neither of these impacts in itself would be regionally significant but would add a small increment to the pervasive increase of sediment and reduction of raptor populations associated with ever increasing development.

The increased annual runoff and sediment into Warm Creek, Wahweap Creek, Lake Powell and Paria after abandonment and mitigation would amount to less than 1 percent a year, which is considered insignificant.

Transmission system impact area

Mitigation measures would reduce impacts on the ecosystem where no soil, water, vegetation and animal disturbance occurs. Where any of these four factors are altered the impacts described in Chapter III could not be completely mitigated. The amount and type of disturbance would affect the degree of alteration of the ecosystem.

Interrelationships of bacteria and other microorganisms would be altered by exposure of the soil and increased soil surface temperature. This increased soil aridity would decrease the rate of the decomposition processes. Surface disturbance and vegetation removal would increase surface erosion reduce the soil moisture level and physically damage animals and their dens, shelters, cavities and nests. The impacts would be alteration of the present ecosystem so that the present flora and fauna may not be able to exist at the level prior to disturbance. Plant communities would be set back to earlier stages of plant succession. Animals adapted to these earlier successional stages would replace those of later stages.

Desert vegetative types would be very slow to recover and on some harsh, extreme sites revegetation would perhaps not occur.

Recovery may take 20 to 50 years or even longer. Grassland vegetative types would be expected to recover more rapidly than desert shrub. Riparian and chaparral vegetative types, because of available soil moisture relationship, would recover much faster than the desert types. The loss of riparian vegetation could be detrimental to migratory birds.

Fauna associated with these plant communities may take longer to reinhabit the vegetative type than it would take for the type itself to recover. Animal populations inhabiting these types are particularly adapted to certain stages of vegetation and as the revegetation process occurs over the years the kinds and numbers of animals inhabiting the area would likewise change.

Limestone quarry impact area

Construction of the quarry would result in a loss of 110 acres after mitigation and abandonment. Another 15 to 20 acres probably could not be re-vegetated due to erosion on the quarry side slopes after abandonment. This situation would result in loss of food for wildlife and domestic animals. This small acreage would not be significant in the region.

The removal of vegetation would increase competition for forage and place a small added burden on undisturbed plant communities at least until some of the vegetation is reestablished.

The impact of human activity would be the major unavoidable impact on ecological interrelationships in the area. Access to hunting would increase and harassment of wildlife would likewise increase. Predatory patterns of some animals would be altered to avoid the presence of man.

PALEONTOLOGY, ARCHAEOLOGY AND HISTORY

Kaiparowits Plateau impact area

Paleontological resources which would occur in the strata overlying coal deposits and in the plant construction areas would be subject to destruction wherever operations cut through that particular strata as in the case of mine shafts, air vents, etc. Secondary impacts would occur wherever there is subsidence. These would include destruction, fracturing and changes in location.

Archaeologically, seven of 50 recorded sites located in the area of the generating station and its buffer zone would be disturbed or destroyed. Of the 26 sites in the coal mine area, an estimated two or three would be directly disturbed or destroyed. These sites would be salvaged to the extent possible under present scientific methods. These sites are of moderate scientific importance. Salvage as proposed would gather data as limited by present technology, however, future "on-site" study would not be possible. Indirect impacts would result to the remaining resources.

Waterline construction would involve disturbance of 620 acres, however, the degree of impact and the number of sites is unknown. There is no inventory of sites on the town site and access highway, but again, future investigation opportunities would be permanently lost.

Current limitations in location, recovery and analytical techniques would result in destruction of certain contexts and relationships between specimens and their environment during recovery operations proposed as mitigating measures. Removal of whole segments of the archaeological resource could seriously impair or prevent future opportunities for unbiased scientific investigation.

Transmission system impact area

Even with full implementation of proposed mitigation, damage and destruction would occur to the paleontological, archaeological, historical and cultural resources. These sites are unique, nonduplicable, and are highly vulnerable to all levels of ground-disturbing activities.

Damage to sites not discovered in survey or construction surveillance would be almost certain to occur. In cases where salvage mitigation is performed, the impact would be negative in that not all possible data can be retrieved; once excavated a site is effectively destroyed and removed from future direct research considerations. Salvage motivation, even if channeled in scientific problem-solving directions, is rarely as effective as nonsalvage research because of limited time, funding, and personnel levels. Emergency salvage, required by unexpected construction-related discovery would be even less effective.

Some loss of historic integrity and interpretive potential would occur due to the intrusion of transmission lines into the setting of sites. This would be especially pronounced in the case of historic trails and at Camp Young.

Avoidance and protective measures during construction and maintenance of the lines would not reduce the threat of indirect impacts. These would result from utilization of the access roads by recreationists and other back-country users, who may cause unintentional damage by driving off the access roads. Collectors and vandals would be attracted to areas previously inaccessible or unknown to them; both formal and word-of-mouth publicity would have the effect of increasing uncontrolled collecting of artifacts. Sanctions against construction and maintenance workers collecting and exploring for cultural materials would probably not be fully effective. Private landowners may be tempted to explore sites they become aware of through the investigations.

The number, kinds, and significance of sites that would be affected and the severity of impacts to them are unknown.

<u>Limestone quarry impact area</u>

Removal of archaeological or historical artifacts from their natural setting would be unavoidable in areas to be developed or quarried. Significant data would not be destroyed if proper survey and salvage were conducted prior to disturbance. However, even with mitigation, sites or parts of sites would be unavoidably damaged or destroyed.

RECREATION

Kaiparowits Plateau impact area

Cultural values

The historic integrity of the Navajo Trail would be destroyed if the proposed new town site on East Clark Bench is developed. Vandalism and looting would occur at cultural sites near the population centers and on travel routes, including the side canyons of Lake Powell.

Natural values

The natural, relatively undisturbed environment of the 7,320 acres of land that would be occupied by permanent facilities would be destroyed including approximately half of the mature pinyon-juniper forest on Fourmile Bench. Recreation use that would be foregone as a result of the removal of vegetation and wildlife would be negligible. The natural environment of the area around Grosvenor Arch would be diminished due to the presence of the proposed new highway and power line. See Chapter III Recreation section for description of off-road vehicle impacts on natural values.

Primitive-wilderness values

The "back-country" area in the vicinity of the proposed plant and mine complex would be ruined for back-country exploration. The Paria Primitive Area, Hackberry Canyon roadless area, Fiftymile Mountain roadless area and primitive values in the Glen Canyon National Recreation Area would be heavily impacted by overuse and vandalism. Other areas such as the primitive values in Escalante River drainage could be heavily impacted by off-road vehicles and associated uses.

Aesthetics

Reduction in visibility and sky discoloration resulting from stack emissions could have a severe adverse effect on the visual environment for the millions of visitors who tour the scenic parks in this region annually. The most severe impacts would be in Bryce Canyon National Park and Glen Canyon National Recreation Area. The magnitude and frequency of these impacts are not well defined. (See Air quality sections in Chapters III and V for more information.)

The proposed plant and mined area complex would constitute a major visual intrusion for the traveler on the proposed new highway. The magnitude of the impact would vary depending on the visibility of the various structures from segments of the highway. (See Chapter III Recreation section.)

The proposed marshalling yard, construction camp and new town site on East Clark Bench could interfere with the traveling public's view of the scenic cliffs to the north and would represent an intrusion on the visual environment.

Recreation use

Increased boating use in Wahweap and Warm Creek bays of Lake Powell would create more boat safety problems and would have a negative effect on the quality of experience for boaters who seek solitude in some of the nearby canyons and bays. Off-road oriented vehicle activities would adversely affect recreational values within an approximate 100-mile radius of the plant. The magnitude of this impact would depend on effectiveness of the planning and control program instituted by various land managing agencies. The greatest impact would likely be near towns where new residents would settle. All accessible areas within a 1/2-hour driving time would be impacted. High interest areas, such as, Glen Canyon National Recreation Area, Dixie and Kaibab National Forests, Capitol Reef National Monument and the upper reaches of Escalante River drainage, all within a 4-hour drive would also be impacted. The impacts would include the following:

(1) Damage to the soil mantle and vegetation resource that would leave ugly scars on the landscape.

(2) Vandalism and looting of archaeological and historical sites.

(3) An increase in littering and man-caused fires.

(4) Destruction of signs, fences and other facilities.

(5) Illegal shooting of wildlife.

(6) Illegal removal of collectable items such as petrified wood, minerals, fossil remains, etc.

(7) Destruction of primitive values by leaving tracks in an otherwise pristine environment.

Deer hunting success within a 100-mile radius in Utah would be lowered unless actions were taken to limit the number of hunters. Deer herds are generally on the decrease in Utah. The increased hunting pressure (approximately 35 percent increase) would likely accelerate the decrease in deer population and bring a decrease in hunter success.

Increased heavy truck and commuter traffic (see Recreation section, Chapter III) would create traffic congestion on the new highway and adversely effect the quality of experience for recreationists traveling this route and visitors at Bryce Canyon National Park.

<u>Transmission system impact area</u>

The unavoidable impacts are considered as a whole for the three proposals since the impacts are so similar.

Adverse impacts on recreation would occur during both construction and operation stages. During construction the effects would be more intense, though of shorter term. Noise, dust and smoke from construction equipment would create some adverse sensory impacts. This would not only deter some recreationists, but would detract from the aesthetics of the outdoor recreation experience. Effects

on recreational activities such as hunting, backpacking and sightseeing near the line during construction might be considerable. The disturbance would likely eliminate hunting from the immediate construction area as well as 1 mile or so adjacent to the disturbance.

The primary impact of a transmission system is visual. Regardless of the number of mitigating measures applied, the transmission system would still create a major intrusion into otherwise natural landscapes. Some skylining and encroachment upon scenic drives, natural areas, recreation areas, or other places of high scenic quality would be unavoidable. Careful location of the transmission system, use of treated tower steel and nonspecular conductors, and a minimum of right-of-way clearing would reduce but not eliminate visual impacts.

The aesthetic and geological sightseeing values of Cottonwood Cliffs would be unavoidably degraded at the preferred route crossing point. The face of the cliff would be spanned by the proposed transmission line, with towers at the top and bottom, plus the existing road used for access. Other geological sightseeing features would also lose some interpretive potential and visitor interest. Although the proposed route does not cross any designated or potential primitive area, some reduction in quality of visitor experience would be likely due to seeing the line from peripheral areas of the Virgin Mountains, the Old Woman Mountains and the Orocopia Mountains. The proposed Arizona Strip preferred alternate passes through the Virgin River Recreation Lands. The unavoidable impacts would be primarily visual though some surface disturbance would also be unavoidable. Also along this preferred alternate would be unavoidable visual impacts to the Virgin Mountain natural and primitive areas and the Las Vegas Dunes Recreation Area.

Line construction in the vicinity of Camp Young would have visual impacts on visitors to this interesting historic site. The interpretive value of this and other historic or cultural sites would also be adversely affected.

Impacts on the Eagle, Orocopia, Coxcomb, Santa Ana mountains, and Mecca Hills would be less mitigable because of the physical inability to restore them to their previous state. Visual, other natural, and primitive values would be adversely impacted for recreationists and naturalists. The proposed route would pass through the Sunrise Mountain Natural Area east of Las Vegas, and would affect this unusual geologic area through surface scarring and visual impact.

The loss of approximately 3,000 acres of recreation base lands would also be unavoidable and would offend many recreationists wherever the transmission systems would go. The transmission lines, roads, and other related facilities would intrude upon hundreds of miles of scenic quality.

<u>Limestone quarry impact area</u>

There would be approximately 240 acres of land permanently affected by the mining operation (i.e., quarry, shop and office, roads, limestone, stockpile, etc.). The change in line, form, texture, and color created by the quarry and associated facilities would be out of character with the surrounding landscape and consequently would adversely effect the visual environment. The mined area is not visible from Johns Valley road, therefore, the number of visitors viewing the area would be small, probably less than 100 annually.

The haul road from the quarry plus administration facilities would be visible from Johns Valley road and consequently would represent an adverse visual effect.

Dust from blasting and crushing operations may be visible for several miles along the Johns Valley road which would constitute a moderate visual intrusion.

The quarry operation would attract some visitors. Travel along the haul road and visitation at the mine could be hazardous to visitors. The 30 round trip truck hauls per day along the Johns Valley road could create traffic congestion and safety problems that could adversely affect tourists using this route.

LAND USE

Kaiparowits Plateau impact area

The loss of 780 AUM's of livestock forage per year on the generating station and mine areas, and 450 AUM's per year from the new town site could not be avoided should the proposed action be implemented. The loss of grazing privileges on these areas would have a serious economic impact on the operators involved. Seven livestock operators would have to locate additional land for grazing, reduce their herd sizes, or quit the livestock business.

A minimum of 1,172 acres of pinyon-juniper wood resources would be disturbed due to construction of the generating station on Fourmile Bench. Smaller acreages would be disturbed during construction of coal mine surface facilities, water pipe line and patrol road, highway, and access road from the aggregate site to the generating station.

Possible future noncoal mineral development would be adversely affected by the proposed developments. Mining for uranium and other possible noncoal mineral resources would be restricted in all areas that would be occupied or developed. Oil and gas drilling would be restricted from occupied sites in the generation plant area, coal mine area, and new town site - a total of 6,480 acres. If drilling were excluded from all generating station property, within new town limits, and occupied sites in the coal mine area, the restriction would total 14,486 acres. If the generating station were located on Fourmile Bench, an estimated 92 million tons of coal beneath the plant site would not be available for recovery as long as the plant existed there. Unknown amounts of sand and gravel under the proposed town site on East Clark Bench could not be recovered if the town were built.

Unavoidable adverse impacts on roads would result from increased traffic and the transport of heavy loads. Impacts would include weakened bridges, damage to road surfaces, use of additional materials for repairs and new construction, and an expanded need for maintenance, upkeep, patrolling, and monitoring. Damage and additional patrolling resulting from increased use would require expenditures for highway and road maintenance exceeding current amounts. Need for new highways would also increase the demand for highway funds. Although part of these expenses could be met through the prepayment of taxes, as provided for by recent Utah legislation, additional costs for upkeep of secondary county roads and federal roads and trails may not be adequately covered.

Transmission system impact area

Livestock grazing

Livestock forage would be unavoidably lost should any of the proposals be constructed. Permanent and temporary loss of forage by proposal would be as follows: (See also Figure V-7 in the Vegetation section)

Proposed Route	AUM's Lost	
	Annual Permanent	Permanent and Temporary
Primary Proposal	75	431
Northern Kaiparowits Proposal	53	363
Arizona Strip Proposal	87	503

The temporarily lost forage would be mitigated through rehabilitation within 5 to 10 years, thus leaving permanently lost forage under tower sites and along permanent access roads. There would be an estimated permanent loss of 6 AUM's on the Navajo Indian Reservation, as there would be less land available for grazing use.

Existing livestock operations could be disrupted by construction activities due to the use and movement of heavy equipment in the area. The potential for fires that endanger livestock and destroy forage would be unavoidable.

Wood products

Unavoidable loss of wood products available for potential use would be through removal of pinyon and juniper trees along the proposed routes. Acreage lost would be as follows:

Proposed Route	Temp. Removal	Perm. Removal	Total
Primary Proposal	1,474	240	1,714
Northern Kaiparowits Proposal	1,162	113	1,275
Arizona Strip Proposal	1,716	308	2,024

It is unknown how many acres removed through temporary disturbance activities would return to wood production over the life of the project as an unknown acreage would be rehabilitated with other types of vegetation. There would also be an unavoidable fire hazard during construction in wood producing areas. Magnitude of impact is unknown in terms of cords of firewood, numbers of fence-posts, and numbers of Christmas trees.

Agriculture

There would be an unavoidable loss to agricultural production on 58 acres of land in Riverside County, California. This impact would be considered minimal by itself; however, it would add another small increment to the steady encroachment of development on the absolutely limited agricultural soil base.

Transportation facilities

An airstrip at Glendale, Nevada, would be unavoidably lost to air traffic by the primary and northern proposals. Construction of the transmission system would force this airstrip to be closed. Additionally, a proposed major airport in Eldorado Valley, south of Las Vegas, Nevada would be unavoidably impacted by the proposed transmission system. The overall impact of these losses in terms of airport availability or inconvenience to pilots is unknown.

Urbanizing areas

There would be an unavoidable loss of land available for development in urbanizing areas due to the commitment of such land to a utility corridor. Additionally, property values in urbanizing areas would be reduced through impairment of visual quality. Residential zoning variability precludes quantification of these impacts. Areas impacted, which would probably also require zoning changes, are listed in Chapter III, Land use and shown on Illustration II-57, Chapter II.

Limestone quarry impact area

Exclusion of livestock grazing from about 240 acres would be an unavoidable adverse effect until part of the area is revegetated. About 130 acres would be revegetated. However, approximately 110 acres would not be reclaimed, and would not be usable for grazing for many years.

Pinenut gathering and firewood cutting would be eliminated from about 130 acres in the quarry area. This would not be significant since there are sources of pinenuts and firewood in the area which are relatively unharvested.

Eventual removal of 50,000 board feet of ponderosa pine would be unavoidable. This timber could be harvested and sold prior to construction. However, revegetation to ponderosa pine is not likely because of the marginal site characteristics, and the ponderosa would be lost.

Open quarry areas and large trucks along access and haul routes would be a safety hazard to recreational users.

The marked increase of heavy truck traffic along the proposed haulage route that would traverse Bryce Canyon National Park and the towns of Tropic and Cannonville, would mean a higher probability of accidents, decreased aesthetic values and increased noise and exhaust emissions - all unavoidable should the primary proposal be implemented. This traffic would involve large 25 ton diesel trucks making 30 round trips per day 6 days each week for 35 or more years.

SOCIOECONOMIC FACTORS

Kaiparowits Plateau impact area

As described, the Kaiparowits Plateau impact area is primarily undeveloped at the present time. The population is sparse. If the project is built, the increased development and population would present impacts.

As proposed, the project includes construction of a new town. The new town, including housing and all necessary community services, is the best method available to significantly control social impacts. The impacts that would result, if the project is built as proposed, are described in Chapter III. Since there are no significant mitigating measures in addition to new town developments, the adverse impacts described in III are unavoidable. These unavoidable adverse impacts are highlighted in Chapter V.

By 1985 an estimated 2,354 basic employees would reside in the proposed new town and about 785 in Page, Arizona. Urbanization in southern Utah would be unique as it would happen in a relatively rural and undeveloped area. Knowledge is limited of adverse effects which cannot be avoided in such areas. Some data are available from urbanization studies in more populous regions. At least one author has pointed to the various, increasing social conditions which could occur with the approval of a Kaiparowits-type project. These conditions represent the beginning of continuous, accelerated change of the kind which creates individual and social instability, lack of trust, and lack of ability to maintain traditional community patterns.

Political base-line changes can be expected to the extent that a large block of voters in the new town could control local and regional destinies.

Other social attributes which have been studied in relation to urbanization may also occur in the plateau and quarry impact areas. Such attributes are stress and stress-related diseases and social problems. (Levine and Scotch, 1970; Schwab, 1949; Simmons, 1954; Janis, 1958; Trumball, 1967; Hall, 1974; King,

1972; Reeder, 1973, Durkeim, 1951). Examples of social and physical conditions related to stress are: alcoholism, drug abuse, cardiovascular impairment and death, suicide, and peptic ulcers. Other studies have related increased incidence of schizophrenia to community development and patterns (Dunham, 1965). School problems may occur (Fantani, 1970). Problems of mental health (Klein, 1968) and delinquency may also occur (Speigal, 1969).

A primary unmitigated adverse impact of this development could come from service lag problems typically accompanying boom town conditions. Providing timely, adequate, attractive housing is usually the greatest problem associated with poorly funded and poorly planned boom towns. Water and sewer inadequacies are often the most critical concerns since these affect human health. Untimely, provision of schools, hospitals, playgrounds, and stores compound the poor environment created by substandard and inadequate boom town housing.

Existing water facilites are not presently adequate from an environmental health standpoint, and additional population would increase water needs. There is no known master plan for this problem; water in the Sevier drainage basin is fully appropriated. Increased water use could divert water from existing uses; the impacts of this action are presently unknown.

A need for mass transit facilities is indicated for commuter convenience and economy, due to the distance from residence to work. No plans for mass transit have been made, although air pollution from automobiles and use of petroleum are two impacts that could be mitigated to a degree by mass transit use.

Another unavoidable adverse impact arises because of typical attitudes concerning housing. Trailer housing is usually thought of as "temporary" housing. The lack of opportunity to live in spacious trailer villages that could provide some feeling of permanency and membership in the community means that many of the

workers in temporary quarters may not enjoy the amenities available to most Americans with much smaller salaries in other areas. Current new town planning for trailer facilities indicates a portion of the trailer villages would be of high density. Some residents would have little or no opportunity to rent anything other than very small lots with minimal amenities.

A boom town does not have to result, if timely development of a quality new town goes according to plan. Should development be delayed or the quality of facilities be low, then some of the impacts projected for the new town would shift to Page, Arizona, with the population shift to there.

If the companies contingency plan, or comparable substitutes, are not timely implemented, adverse boom town effects would prevail and the creation of a makeshift, inhospitable community would be unavoidable. Of critical importance is how the guarantees of the participants contingency plan would be enforced should they abandon or only partially implement the plan.

Regardless of how well the contingency plan and other efforts are implemented, some discomfort and inconvenience must be expected. Planning for the industrial development to attract employees is far ahead of planning for the service and housing needs that would be created by the development.

Although new job opportunites would be created, the potential economic benefits to residents would not be fully realized. Many Indians on nearby reservations, and many local residents desiring work in the plant and mines would not be able to do so because of lack of training and because a high percentage of new employees would be recruited from other areas. This would be an adverse impact for the area since regional unemployment and under-employment would not be reduced.

Trained migrants would benefit from this situation since their skills would be in demand. Indigenous low income groups would become further depressed

due to greater competition for housing and income. Thus, there could be tension between present residents of the area who attempt to maintain established and traditional sociological patterns and the trained migrants to the area whose socioeconomic and political interests differ from those of the present community.

Revenues generated in state and local taxes would be substantial once the project was underway, and this should offset some needed state government or local expenditures. While there are some socioeconomic impacts that could be mitigated through proper planning and management, it is not known at this time what effects these mitigating measures would have on generation of tax revenues.

Kanab and Boulder are in better economic condition than most other towns in the impact area. The Kaiparowits power plant and new town would cause change in these two communities, and these effects would be adverse if local citizens are unable to influence the change and corresponding physical growth.

Transmission system impact area

Should construction take place during the peak summer travel season, between 45 and 90 motel or hotel rooms would be rented at any one place or time along any of the four transmission line segments. Tourists who could normally rent these rooms would have to extend their trips to areas where lodging would be available.

Although some Indians in Arizona and California oppose passage of transmission lines across their lands, there is no information to indicate how many are for or against proposed transmission line construction, or to quantify the number of Indians who would be culturally impacted or the severity of the impacts. Some Indians feel the lines would impose non-Indian enchroachments on their lands, deteriorate the natural environment of their lands, or make difficult the preservation of their past life style.

Many people within the four-state region support a nongrowth or a slow-growth policy, and others oppose transmission line construction for ecological or conservation reasons. They feel continued unregulated growth is not in the long-term interests of the nation and that their life style would be adversely impacted.

Limestone quarry impact area

There is presently no plan for routing of heavy trucks from the limestone quarry and industrial traffic around such small towns in Garfield County as Tropic and Cannonville. Noise from this traffic would have a disrupting influence on residents of these communities. Truck and other traffic on the new highway into Cannonville could cause major safety and law enforcement problems. At the same time, if a new highway is built there would be an increase in retail trade activities in the Cannonville and Bryce Valley area.

IMPACTS IN THE MARKET AREA

Impacts on the southern California and Arizona market areas are discussed in detail in Chapter III. Some adverse impacts may be mitigated by increased concern about air pollution, mass transit, open space preservation, and planning. Since adequate energy supplies facilitate continued urban growth and sprawl in the market areas, the quality of community life in the market area would probably deteriorate. None of the impact can be attributed directly to Kaiparowits, but only to the overall increase in available electricity.

Although need for electricity and urban development are related, neither can be said to cause the other. Along with food, fuel, and other materials needed for urban existence, in the industrialized world electricity is paramount. Severe impacts can occur if at some point urbanization requires more electricity than is available, or the availability of electricity facilitates too much urban growth.

Thomas and Schneider have expressed some ideas regarding water which can be applied to electricity as a resource in the market area (Thomas, 1970). Present land use patterns and use of available resources are generally determined by other resources than electricity, due to its readily transportable nature. These urban activities are affected by the amount of electricity available, and there is a high positive correlation between the increase in available electricity and urbanization in the market area. Indirectly the development of electrical energy sources may impact beneficial land use patterns and recognized property rights.

KAIPAROWITS

ENVIRONMENTAL IMPACT STATEMENT

CHAPTER VI

THE RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF MAN'S ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

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CHAPTER VI

RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF MAN'S ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

SUMMARY

No significant impacts on climate have yet been measured in the Southwest as a result of emissions from large coal-fired power plants and no significant impacts on climate would be expected from the Kaiparowits power plant or associated transmission system. The National Oceanic and Atmospheric Administration (NOAA) is currently conducting studies in the Four Corners area in order to gain information to determine the effects of large scale coal related energy development on regional climate. NOAA has indicated that it is reasonable to assume that there is yet insufficient data to assess the long-term meteorological consequences of coal development.

The exceptionally high quality of the atmosphere, as it now exists in the Kaiparowits area, would be committed to a degree of quality degradation should plant development begin. The air would become a receptacle for coal combustion products such as sulfur oxides, nitrogen oxides, particulates, (including fly ash, sulfates, and nitrates) trace elements, radioactive elements, carbon dioxide, and water vapor. Solid, liquid, and gaseous contaminants emitted to the air are ultimately removed within a period of time by a number of processes. The residence time in the atmosphere of sulfur dioxide, nitrogen dioxide and particulates generally varies from a few hours to a few days, so the duration of air quality degradation as a result of the Kaiparowits project would generally coincide with the duration of the project. The addition of particulates and chemical transformation of gases to particulates would affect visibility in the area during the life of the project. The effect on air quality of the area by the anticipated population increase could be of longer term impact than the life of the plant.

The proposed Kaiparowits site is within 36 miles of the existing 2,250 MW Navajo power plant. Although interaction between the two plants is not expected to be high in frequency, federal and the more stringent Arizona state air quality standards could be in jeopardy when cumulative effects occured. Five additional coal-fired power plants (860 to 2,085 MW) are within a 200 mile radius of Kaiparowits. Considering the separation distance, relationship of plant sites to prevailing winds, large atmospheric dilution potentials, interposing terrain features and types of emission controls proposed, the probability of emission interaction between the plants and the Kaiparowits plant appears small. However, there is presently insufficient background information to fully evaluate the long term and cumulative effects of the present energy development scenerio on air resources, visibility, and elemental buildup through long range transport to areas of higher accumulation.

During the 35 year life of the project 420 million tons of coal would be mined and another 420 million tons of coal no longer recoverable and therefore lost for the long-term. The short-term benefit would be the potential replacement of 33,460,000 barrels of crude oil that would not be needed for a 3,000 MW power plant.

As a result of the project 7,320 acres would no longer be available for grazing by livestock and wildlife in the Kaiparowits Plateau area, nor 1,700 to 2,030 acres along the transmission line, nor 110 acres within the limestone quarry.

Another 1,375 acres would lose 70 percent of its vegetative cover due to salt drift from cooling towers. Some years after abandonment, productivity of an additional 124 acres would be lost due to erosion of side slopes around the fly ash- scrubber residue disposal site, as well as 20 to 30 acres within the limestone quarry.

The project would use about 60,000 acre feet, of water annually. This use combined with water demands for other energy development in the Colorado

River basin could significantly affect long term productivity in the region. Colorado River salinity would increase 2.0 milligrams per liter (mg/ℓ).

Project activities would impair wildlife habitat values on some 8,175 acres. Recreation land would be diminished on 12,850 acres around the new town and power plant and on 46,130 acres within the coal mining area.

In the short run the project will provide new jobs in the Kaiparowits area, and add to property tax base and some tax revenues. It will also transform the life style of the residents in the area.

The Kaiparowits power project would consume or lose an estimated 15.78 quadrillion (10^{15}) Btu's during its project life while generating a 2.5 quadrillion Btu's of electricity for use in the market area. This indicates an efficiency of 16 percent. The energy expenditure does not include the energy required to maintain the transmission lines, the energy to transport workers, the energy to transport limestone, nor the efficiency of electrical use in the market area.

CHAPTER VI

RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF MAN'S ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

INTRODUCTION

Both short-term and long-term development and use of resources would change long-term productivity of impacted areas. The most intensive change would occur in the generating plant and mine vicinity. Less intensive changes would result from construction of the transmission line. Power supplied by the development would allow continued growth in the market area.

Development of the Kaiparowits power project would introduce buildings, roads, vehicular traffic with resultant noise and emissions, transmission lines, stockpiles of materials and waste effluent, noise from construction machinery and power plant operations, air pollution, increased diesel fuel consumption by truck traffic, and more people in areas essentially unaltered by man.

Remote areas may become more accessible than ever before. Even though project life is estimated at 35 years, industrial history suggests that changes would be long-term or permanent. Based on past and present experience, it appears logical that any major structure existing for 30 years can be considered permanent for long-term effects. Whether the same structure or replacement structure for different uses, it can probably be stated that once development of the Kaiparowits Plateau begins, the course of action would not be reversed some 35 years later. Additional development of the coal resource may be spurred on by this project. For analysis purposes, short-term is considered the period required to construct and place the project into operation. This short vs. long-term analysis covers the entire proposed project as a synopsis of possible environmental consequences of implementation.

Both short and long-term development of this region would alter long-term productivity of natural resources within the area. Transmission line

construction would change a much wider area and also areas surrounding such towns as Phoenix, Las Vegas and Los Angeles. Additional power would allow continued growth, attendant long-term environmental impacts and reduction of natural resource productivity adjacent to these cities.

Major emphasis and discussion of change is centered around the Kaiparowits Plateau area. It would be transformed from a relatively undeveloped, ranching oriented area into an industrialized region with coal mining and subsequent electrical energy production as the dominant industrial and financial foundation. Man's presence would be abundantly evident.

Long-term use of the various resources such as air, vegetation, wildlife, aesthetics, recreation, minerals, etc., would be affected by the project in different ways. Such resources would remain productive, except possibly vegetation and wildlife which would decline and eventually reach a new level of stability at a lower productive rate. Decline in productivity would be immediate upon initiation of construction and continue until activity ceases or settles into some type of consistent pattern. If this point is reached, the ecosystem would be expected to stabilize with resource production at a different level than existing prior to project implementation. Data are not available to determine time required for stabilization or the level it may reach. However, a logical assumption is that the total productivity level would be lowered.

No significant impacts on climate have yet been measured in the southwest as a result of emissions from large coal-fired power plants and no significant impacts on climate would be expected from the Kaiparowits power plant or associated transmission system. The National Oceanic and Atmospheric Administration (NOAA) is currently conducting studies in the Four Corners area in order to gain information to determine the effects of large scale coal related energy development on regional climate. NOAA has indicated that it is reasonable to assume that there is yet insufficient data to assess the long-term meteorological consequences of coal development.

AIR QUALITY

Air would be a receptacle for combustion products such as sulfur oxides, nitrogen oxides, particulates (including fly ash, sulfates, and nitrates), trace elements, radioactive elements, carbon dioxide, water vapor and methane.

The exceptionally high quality of the atmosphere, as it now exists in the Kaiparowits area, would be committed to a degree of quality degradation should plant development begin. Solid, liquid and gaseous contaminants emitted to the air are ultimately removed within a period of time by a number of processes (Dames and Moore, 1971) (Hill, 1971).

The residence time of sulfur dioxide (SO_2), nitrogen dioxide (NO_2), and particulates generally varies from a few hours to a few days, so duration of air quality degradation in any particular area coincides with duration of the emission source in that area. For the Kaiparowits power plant, the predicted concentration levels of SO_2, and SO_2 plus NO_2 would be below those actually affecting plant growth. The addition of particulates and chemical transformation of gases to particulates would affect visibility in the area.

Sulfates, nitrates, phosphorous and trace elements released to the ecosystem have potential long-term effects on soils, plants and animals. Pathways through the ecosystem of many of these elements and the potential influences of fossil fuel generating plants are only now being defined. Bioaccumulation and biomagnification, as defined for mercury (Standiford, Potter, Kidd, 1973), could be anticipated with other trace elements. The release of small amounts of radioactivity to the atmosphere due to coal combustion would cause only a small increase in radiation exposure of the general population, well within acceptable exposure limitations. The long-term cumultive effect of this increase is not known.

Located within 200 miles of the proposed Kaiparowits plant site are six operating coal-burning power plants that have or are expected to have an

800 megawatt (MW), or greater capacity (Four Corners, 2,085 MW; San Juan, 1,660 MW: Navajo, 2,250 MW; Cholla, 965 MW; Mohave, 1,510 MW; and Huntington, 860 MW). Also within an approximately 100 mile radius of the proposed Kaiparowits site are seven national parks and monuments and four national forests. The potential for cumulative effects of emissions from these existing or planned generating plants becomes an important consideration. The eight-county area of southwestern Utah, which includes the Kaiparowits site, has been designated as part of the Four Corners Interstate (Arizona, Colorado, New Mexico, and Utah) Air Quality Control Region (AQCR) by the Environmental Protection Agency (EPA). Four counties within the AQCR have been proposed as Air Quality Maintenance Areas (AQMA) by EPA. Such a designation is made for an area which appears likely to exceed air quality standards during the 1975-1985 period so that appropriate measures can be taken to maintain air quality standards. The Kaiparowits site is within the proposed AQMA.

The proposed site of the Kaiparowits power plant is 36 miles northwest and approximately 2,000 feet above the Navajo power plant that has started its first and second units. The Navajo plant is projected to be a 2,250 MW coal-fired generating station when completed.

Before the Navajo plant came on line, existing power plants and associated development around the Kaiparowits site had had little apparent influence on the area.

Monitoring of air quality near the Navajo power plant by the Arizona Department of Health Services began in 1969 (Arizona Department of Health Services, 1975). Annual geometric mean particulate concentrations increased from 17 micrograms per cubic meter ($\mu g/m^3$) in 1969 to 52 $\mu g/m^3$ in 1973, then leveled off at 48 $\mu g/m^3$ in 1974. The Arizona Department believes this to be a reflection of

population growth and construction activities associated with the Navajo power plant from 1969 to 1973. These levels are close to Arizon's particulate standard of 60 $\mu g/m^3$.

Units 1 and 2 of the Navajo plant became operational in 1974. Annual SO_2 and NO_2 concentrations increased from 1 to 10 $\mu g/m^3$ in 1973 and to 8 and 24 $\mu g/m^3$, respectively, in 1974 as a result of plant operation. Arizona's standards for SO_2 and NO_2 are 50 and 100 $\mu g/m^3$, respectively, for an annual average.

The Southwest Energy Study (SWES) predicted no significant additive effect from the emission by one plant on those of another if the plants were separated by about 60 miles (100 kilometers (km) or more (SWES, Appendix E, 1972). SWES also predicted that for plants within approximately 16 miles (25 km) of each other, there could be additive effects in long-term and short-term concentrations; in the latter case primarily when one plant effluent is blowing toward another. The Kaiparowits-Navajo case lies between these two conditions.

Williams (1975) suggests that if the Navajo plant does not install SO_2 scrubbers, the federal standards could be closely approached, particularly when higher sulfur portions of the coal field were used. Any significant contribution from Kaiparowits might cause the ground level concentration to be exceeded. This conclusion is supported by the analysis of the Arizona Department of Health Services (1975). William's study indicates that a possible area where both plumes might affect the same area would be Tsai Tskizzi rock within 28 km of Navajo and 58 km of the Nipple Bench site. At that point the Kaiparowits contribution would be estimated to be 8 $\mu g/m^3$ on the 24-hour average while the Navajo contribution would be approximately 260 $\mu g/m^3$. The interaction would exceed Arizona sulfur dioxide limitations. Williams also suggests that another potential area of plume interaction could be the southern edge of Fourmile Bench. The study estimates that Navajo could contribute approximately 600 $\mu g/m^3$ for a

3-hour level and 135 $\mu g/m^3$ for the 24-hour case. At a distance of 18 km and an elevation of 6,300 feet, Kaiparowits could contribute 128 $\mu g/m^3$ for the 3-hour and 29 $\mu g/m^3$ for the 24-hour case. In this case the applicable standards would not be exceeded.

The Air Quality Section of Arizona Department of Health Services indicates that with the emissions from three units of Navajo (7.25 tons per day of particulates, 230 tons per day of SO_2, and 280 tons per day of NO_x), the cumulative effect of emissions from Kaiparowits and Navajo could cause a rapid degradation of existing air quality and that national ambient air quality standards could possibly be exceeded in areas distant from the plants. Williams submits that the projected emissions from the Navajo and Kaiparowits plants, considering proposed emission controls would be 234 tons of SO_x and 446 tons per day of NO_x (using the Arizona Department of Health data on Navajo plus predicted Kaiparowits emissions, these would be 248 and 530 tons per day, respectively). A single day's emissions mixed through 2 km vertically and within a 50-mile radius would add 98 $\mu g/m^3$ of NO_x through the volume assuming no conversion of NO_2 to nitrates. During a 5-day stagnation period the approximate 0.25 parts per million (ppm) threshold level for visible NO_2 discoloration could be approached. SO_2 concentrations, assuming no conversion to sulfates or other SO_2 losses, would be about 250 $\mu g/m^3$, which approach the Arizona 24-hour limitation of 260 $\mu g/m^3$.

The Joint Meteorological Report (1971) considered the potential for cumulative impact on air quality for the Four Corners, San Juan, Mohave, Navajo, and Huntington power plants. The preliminary study considered available meteorological, air quality, and topographic data. The results indicated that under stagnation conditions, there would be no interaction of emissions between these five plants. Air quality measurements made subsequently at Page, Arizona, near the Navajo plant showed that before the operation of the Navajo plant, that

sulfur and nitrogen oxides remained at or near the limits of detection of the measuring instruments during the operating time of the San Juan and Four Corners plant, which supports the study conclusions. Additional proposals in various stages of development are four coal-fired power plants (ranging in size from 500 MW to 3,000 MW) and two proposed coal gasification plants within a 200-mile radius of Kaiparowits. Based on the conclusions of the Joint Meteorological Report (1971) and the Meteorological Group of the Southwest Energy Study (1972) the probability of interactions of emissions between these plants and the Kaiparowits plant appears small, considering the separation distance, relationship of the plant sites to prevailing winds, large atmospheric dilution potentials, interposing terrain features and types of emission controls proposed. However, there is presently insufficient background information to fully evaluate potential long-term and cumulative effects of the present energy development scenario on air resources, visibility, elemental buildup through long-range transport to areas of higher accumulation such as high elevation ecosystems have been identified as being efficient accumulators of air pollutants and could be among the first to show long-term subtle accumulation of air pollutants.

MINERALS

In the short-term, use of low sulfur coal reserves could help meet spiraling energy demands while also meeting current air quality regulations. Coal mining would constitute recovery and utilization of a natural resource, thus contributing towards the nation's self-sufficiency in energy sources. Use of this resource would save alternate fossil fuels in short supply and may help provide additional lead time for research development and increased long-term productivity of more exotic energy sources, i.e., wind and solar power.

The use and commitment of 24,000,000 tons of coal annually (12,000,000 mined; 12,000,000 left in place at 50 percent recovery) involves a trade-off between fuel oil and coal. To produce the same amount of electrical energy (3,000 MW) would require approximately 33,460,000 barrels of crude petroleum annually. (See subsequent section for computation.) At present, crude oil (nonimported) is in short supply.

Use of coal would reduce drain on the nation's crude oil supply. However, use of coal under present technical knowledge would result in some reduction of potential long-term productivity. Mining of coal under constraints of present extraction techniques would result in limited resource recovery (50 percent) that could conceivably improve with future technological advances. Direct burning of coal for power generation is relatively inefficient with only 35 percent of the heat value being converted to electric energy. Again, coal-fired power plant technology is improving and would increase efficiency within the 35-year project life.

The plant site area would cover approximately 92 million tons of coal. Use of this resource would not be possible during plant life and productivity of the coal resource would be lowered by this amount during this period. Deferring recovery of this coal could mean future recovery of a larger percentage through advancement of mining technology expected to occur.

The short-term uses of coal may benefit long-term productivity by allowing conservation of other fossil fuels in short supply and development of alternate energy resources. At the same time short-term use of coal at today's efficiency rates is reducing possible long-term productivity of this resource which could improve with technological advances.

Even though use of coal would enable conservation and extended life of the crude oil resource, the Kaiparowits plant would require consumption of some fuel oil for burner ignition which would add to the long-term depletion of oil. The plant would use an estimated 10 million barrels of fuel oil during its projected 35-year life.

The short-term use of various industrial minerals - aggregate, clay or mudstone, and limestone - would meet construction and technical needs of the project and related town and road development. Aggregate and clay (mudstone) would be extracted principally during initial construction phases. Limestone would be utilized throughout life of the plant and coal mines, perhaps 35 to 50 years. During the life of the project, utilization of these minerals is not only beneficial, but essential to the project and related developments. Over the long-term or beyond project life, minerals extracted would no longer be available, but remaining reserves would be adequate based on anticipated needs. Over the long-term, aggregate, clay and limestone would become less accessible to the market areas. Short-term use of these minerals, therefore, would result in some loss of long-term productivity. Also, some land areas would be affected by subsidence.

SOILS

Long-term soil productivity would be lowered by the project even after abandonment. Some short-term productivity, especially along the transmission lines, access roads, and around the power plant would be lowered during construction and operational stages. Reclamation of the disturbed areas would be expected to eventually restore them to near current productive levels. However, reestablishment of soil productivity may be slow due to arid and semiarid climatic conditions.

Productivity on 7,320 acres (generating plant - 930, water pipe line - 225, new highway - 280, coal mine - 1,649, new community - 3,900, and aggregate sites - 332) would be eliminated by the project. This area would be covered by man-made structures such as access roads, towers, plant facilities, etc. An additional 110 acres of productive soil would be lost through construction and operation of facilities at the limestone quarry. Another 20 to 30 acres would become nonproductive a number of years after abandonment, when maintenance of the reclaimed side slopes is no longer practiced.

After 50 years of salt accumulation from cooling tower drift, productivity of 1,375 acres would be reduced an estimated 70 percent by the salt accumulation that would raise the soil electrical conductivity to greater than 4 millimhos (EC x 10^3) which is considered injurious to sagebrush, pinyon and juniper (Bernstein, 1958; Gates, et al., 1956; Richards, 1954). Also trace elements such as arsenic, barium, boron, fluorine, lead, mercury, selenium, titanium and vanadium contained in the power plant stack emissions would be deposited into soils within a 30-mile radius of the plant.

The trade-off involved in this long-term loss is unquantifiable with available data. If not used for project purposes, this soil could certainly continue to grow and furnish wildlife habitat and forage for domestic livestock.

In addition to the above identified areas, another 124 acres around the side slopes of the fly ash-scrubber residue site would be lost to productivity within 3 or 4 years after abandonment due to erosion. (See Soils in Chapter III for specific analysis.) This particular side slope acreage would no longer be suitable for vegetative growth under any circumstances because the exposed fly ash-scrubber residue is comprised primarily of a calcium sulfate cementing material. Calcium sulfate is considered to have a solubility of 0.209 grams per 100 cubic centimeters of cold water. Once the side slopes become exposed, approximately 3/16 of an inch could wash off annually under normal conditions. This would be equal to 1.9 acre-feet per year.

Construction of the transmission system would result in additional loss of soil productivity. The following figure provides the possible extent of acreage loss or disturbance which would be associated with each of the possible transmission system routes.

FIGURE VI-1

Acreage Disturbed by Transmission System

Route	Area Disturbed (acre)	
	Permanently Removed	Temporarily Disturbed
Primary Proposal	1,715	7,370
Northern Route	1,490	6,885
Arizona Strip	2,030	8,685

Acreage permanently removed by access roads, tower footings, etc., would be lost to productivity of any type. The acreage temporarily disturbed would be eventually reclaimed and made productive again, but this could involve long time spans, from 5 to 50 years. Productivity of the immediate area would be lowered; however, the total amount when compared to the vast acreages crossed by the transmission system does not seem to be significant.

Soil would also be lost from various areas due to increased erosion and sedimentation rates. Increased recreational use, especially by off-road vehicles, would affect soil productivity on additional acreage. The possible extent of this effect is unknown.

WATER RESOURCES

The project would use ground and surface water. Water use during power line construction would amount to an estimated 1 acre-foot for mixing concrete. This amount would be removed from the hydrologic cycle and be unavailable for other resource use. Approximately 120 acre-feet would be used for dust control on transmission system roads and would be returned to the hydrologic cycle. Water would come from ground water and perennial streams. No significant short-term or long-term effect is expected from this use.

The mining and power plant operation may use an estimated 50,000 acre-feet of water per year from Lake Powell. This use would preclude withdrawal for other purposes, including municipal, industrial, recreation, wildlife, and agriculture. For instance, this amount of water could support a population of 250,000 people (200 acre-feet per year per 1,000). It would also support 16,700 acres of irrigated agriculture, (using 3 feet per acre), or about 12,230 head of domestic cattle and large numbers of wildlife.

The proposed new town associated with the project would utilize an estimated 9,690 acre-feet of ground water annually. About 50 percent of this would be available for reuse in irrigation of parks, greenbelts, golf courses and lawns, but the other half would be lost to other uses. Population increases in nearby towns would increase the combined water use for public supply in those towns by an estimated 40 acre-feet per year making that water unavailable for other uses.

This water use would likely continue for an indefinite period, but would probably not have significant effects on long-term productivity of the area. However, the combined water uses of this project and other energy-related projects in the Upper Colorado River Basin could significantly affect long-term productivity of the region. Projected water needs for all energy-related projects

that are in progress, definitely planned or projected, would total nearly 900,000 acre-feet per year by the year 2000 (U.S. Dept. Interior, Water for Energy Management Team, 1974). About 15 percent of this need (135,000 acre-feet) would be for projects currently in progress that include: Navajo, Four Corners, San Juan, Naughton, Jim Bridger, and Huntington Canyon power plants and an oil shale project in Colorado. Complexities involved in appropriation of the required water for these energy-related projects preclude quantification of their salt loading and concentrating effects on the Colorado River. These effects could be large considering that the proposed Kaiparowits project alone would increase lower Colorado River salinity by an estimated 2.0 mg/ℓ.

With proliferation of these energy-producing, water-using projects, the cumulative effect of this water use on the long-term productivity could span many types of resources and uses, i.e., aquatic life, wildlife, agriculture, recreation.

VEGETATION

Short-and long-term vegetative productivity would be lowered by the project. Long-term productivity would be affected by permanent removal of vegetation by project facilities. Even though temporarily disturbed areas would be reclaimed, the time required to return to current productive levels would vary considerably.

Vegetation would be temporarily removed from 9,460 acres. An additional 240 acres of vegetation would be temporarily removed by the limestone quarry operation. Approximately 7,320 acres would be occupied by all facilities where vegetation could not grow. Loss of this vegetation would lower the productive level of this area for wildlife and livestock grazing to obtain production of 3,000 megawatts (MW) of electrical energy. This vegetation currently supports a wide and diverse range of animal life, including livestock.

Within 50 years, some 1,375 acres would be impacted by salt drift from cooling towers resulting in an estimated 70 percent reduction in vegetative cover. At this time the soil electrical conductivity would equal or exceed 4 millimhos (EC x 10^3) which is considered injurious to sagebrush, pinyon and juniper (Bernstein, 1958; Gates et al., 1956; Richards, 1954). The remaining 30 percent of the vegetative cover would consist of grasses and forbs that are tolerant to an electrical conductivity level of 4 millimhos (EC x 10^3).

Long-term vegetative productivity may be affected by power plant emissions. Deposition of sulfur oxides, nitrogen oxides, phosphates and trace elements on vegetation may reduce density and cause changes in composition. The effect of these emissions is little understood at present, but the potential should be recognized.

Construction of the transmission system would also cause permanent removal of vegetation as shown in Figure VI-1. Depending on route selected, the amount removed and disturbed would vary.

In addition to loss of productivity on acreage permanently removed, the project would affect long-term productivity on areas temporarily disturbed. The arid and semiarid climatic factors would make recovery of various vegetative types an extremely long-term situation. Based on the four major vegetative types found along the transmission routes and estimated recovery rates, Figure VI-2 illustrates the time and acreage involved on the various proposed routes.

FIGURE VI-2

Estimated Time Required for Recovery of Vegetative Community
(To 80 - 90 Percent Present Vegetation)

Major Vegetation Associations	Time for Recovery to 80 - 90 % (years)	Area Covered (acres)		
		Primary Proposal	Northern Route	Arizona Strip
Mohave and Sonoran Desert Shrub	20-50	1,781	2,058	2,719
Great Basin Desert Shrub	5-20	1,951	1,756	1,840
Pinyon-Juniper	20-100	1,474	1,162	1,716
Grassland	5-10	967	617	1,049

Further compounding the problem of reduced productivity on these areas is the potential for successful reclamation. The same factors that lengthen recovery time also reduce potential for successful reclamation. The estimated reclamation success potential and acreage involved in each class is shown in Figure VI-3.

FIGURE VI-3

Reclamation Potential

Reclamation Success Potential	Area Covered (acres)		
	Primary Proposal	Northern Route	Arizona Strip
Less than 20 percent	5,306	4,957	6,253
20 to 50 percent	1,769	1,652	2,084
Greater than 50 percent	295	276	348

As can be seen from the figure, approximately 72 percent of the disturbed area for each proposal would have a success potential of less than one chance in five in any one year. Each passing unsuccessful year lengthens the time required to return to current productive levels.

Reduced vegetative productivity along the transmission lines could outlast the projected life of basic project facilities. Loss and reduced productivity would affect production of various living organisms as a trade-off for electrical energy production.

WILDLIFE

Loss of habitat from structural features on about 7,320 acres on the Kaiparowits Plateau impact area, 1,575 acres along the transmission corridor, and 240 acres at the limestone quarry would be permanent, resulting in long-term decline of wildlife productivity. About 1,207 acres of the permanent loss on the Kaiparowits would be predominantly pinyon-juniper woodland habitat capable of supporting about 12 deer year-round or 40 deer seasonally. The new town on East Clark Bench would cause permanent loss of 3,900 acres of antelope habitat in an area where efforts are underway to reestablish a herd. As a result of this loss plus the activity in the area, the possibility of reestablishing the herd would be permanently lost.

Habitat values on an additional approximately 8,175 acres disturbed by mining, construction, etc., would be seriously impaired. Certain habitat components for most big game species would not be restored. In some desert areas along transmission lines, disturbance and intrusion by people could seriously affect bighorn sheep survival. Some isolated populations might be eliminated. In other areas, such as Sonoran and Great Basin desert shrub, wildlife production may never return to current levels. As discussed under vegetation, disturbance of various acreage and length of time required for reestablishment would affect long-term productivity of wildlife.

Salt accumulation from cooling tower drift would eliminate pinyon-juniper and sagebrush vegetation on 1,375 acres capable of supporting about 20 deer year-round and 60 seasonally. Some salt tolerant plants probably would partially replace the lost sagebrush but would be less palatable to most wildlife.

Accumulations of salts in the watershed would continue to cause reduced productivity in wildlife habitat for a number of years beyond project life.

Usually, animals displaced from occupied areas would be lost, since normally there are no "unoccupied" areas for them. The loss could be even greater

because of habitat limitations on surrounding areas. Additions to habitat already at carrying capacity could result in habitat degradation and loss of migrant numbers as well as a certain number of residents. Because of climatic conditions, habitat recovery could take many years; therefore, long-term wildlife productivity of the surrounding area could be significantly lowered by the proposed project.

Perhaps of more long-term significance is the effect of increased human population, and activities, both business and leisure, of that population. Population increases would take place in the Kaiparowits area and in the three metropolitan areas to be supplied by the project. Long-term effects could also be felt in those remote, currently inaccessible areas that would become accessible through transmission line construction and associated access roads. Total acreage affected by this increased human activity cannot be estimated in specific terms. However, an estimated increase in annual use of approximately 13,700 man-days of hunting, 15,000 man-days of fishing, and 40,000 man-days of off-road vehicle use could be expected within a 100-mile radius of the new town and would almost certainly persist beyond life of the project.

Long-term productivity of wildlife would be reduced. As human activity increases, vegetation is reduced and the plant composition changes to species that may not be favorable for continued existence of certain wildlife species. Wildlife would also experience increased harassment from high human populations causing them to vacate favorable habitat with a cumulative effect on surrounding habitat. This would reduce quantity and quality of habitat and, therefore, wildlife numbers.

Accumulations of mercury in sediments at the bottom of Lake Powell would continue to present the hazard of mercury contamination in game fish long past the proposed life span of the project. The contribution by Kaiparowits to the total mercury load of Lake Powell would be a long-term project impact.

Accumulations of other toxic elements such as arsenic and selenium also would create potential hazards to all wildlife, including invertebrates and microorganisms beyond the life of the project.

Loss of wildlife resulting from depletion of any springs or seeps that might result from alteration of aquifers or withdrawal of ground water would be a long-term loss.

For fish and wildlife there would be few, if any, short-term benefits to be balanced against the long-term losses.

PALEONTOLOGY, ARCHAEOLOGY, AND HISTORY

Assessment of the paleontological, archaeological, and historical values involved and dissemination of information obtained would provide immediate gains to scientific knowledge and would provide a data base for future studies. Construction would result in short-term accumulation, through examination of sites to be affected, of additional knowledge concerning past history.

Great technological strides have been made in recent times in the archaeological field; future advances in techniques are expected to allow gathering of even more detailed data from ruins and sites. Examination, study and excavation of these sites now, using current methods, would not produce as much information as preserving the sites for future study utilizing more advanced research strategies and techniques. Uncontrolled loss of values would also occur from increased use and vandalism, removing those sites affected from future research use or damaging them to the extent that research potential would be diminished.

RECREATION

Project development would change the nature of the area's recreation productivity. Present recreation experiences are those associated with wild, scenic and undeveloped lands, and are aesthetic in nature. Both development and the people associated with it would change this. Since there would be more people participating (14,000 increased population), there would in one sense be more recreation. However, it would not be primitive land based. Use of the areas, including Lake Powell and adjacent parklands, would be more intensive rather than extensive. The proposed new access road would shorten travel distances considerably and would likely be heavily used by recreationists on their way to Lake Powell. If the Park Service constructs a proposed road from Bullfrog to Glen Canyon City, intense use could be placed on the Warm Creek area of Lake Powell.

At the same time and for the same reasons, aesthetic values of the area involved would change. These changes would be permanent and long term. Additional structures, such as power plant facilities, transmission lines, microwave sites, increased traffic, and urbanization would change the area's character. Typical open space views would become fewer (1,440 to 1,476 miles of new transmission lines). Also, on days of air stagnation and inversion the pollution from the power plant would obscure the view from Bryce Canyon. Both local residents and tourists would be affected by this change.

There would be a diminished recreation land base. A total of 8,941 acres would be occupied during the life of the facilities. This would change 9,160 acres from government to private ownership. However, access roads constructed for the project would open up new areas heretofore unavailable to the average recreational user. There are 735 to 1,055 miles of new road along the transmission lines and 67 miles of new highway.

In summary, it is not apparent whether long-term productivity would be diminished or increased. Impacts of the project on recreation could have a balanced overall effect, but the type of recreational use would be definitely altered.

AGRICULTURE

Some long-term loss in productivity could result from increased population and urbanization in the immediate project area. Long-term loss of agriculture production in Phoenix, Las Vegas and Los Angeles could result from population increases based on adequate supply of electrical energy.

Some long-term loss in livestock production would occur. This loss involves 740 animal unit months (AUM) on the plant site, 40 AUM's on the mining area, 64 AUM's in the limestone quarry, and about 450 AUM's within the proposed town site - a total of 1,294 AUM's. This loss would come from construction of permanent facilities. Additional AUM's would be lost on an annual basis from construction of the transmission system. Depending on route selection, this loss would range from 53 to 87 AUM's. Loss would also occur on the disturbed areas until they were reclaimed and again producing at the same level. For grasslands, this could require from 5 to 10 years. Although total loss of AUM's is not expected to be significant in terms of overall agricultural productivity, it would feed approximately 38 head of cattle on an annual basis which is a trade-off for producing 3,000 MW of electrical energy.

SOCIOECONOMICS

Evaluation of many social and economic effects, both short and long-term, depends a great deal on the observer's personal value system. Development of the project would provide at least an estimated 3,000 new jobs at the mine and power plant. This does not include temporary construction jobs. Even though jobs would be created, the skills needed would require most employees from outside southern Utah. Some local people, however, would benefit to some degree by having additional, higher-paying job opportunities. In addition, the average income of those who would be employed could be expected to rise substantially. Coupled with local expenditure by industry, the net result would be a possible major increase in regional income with a possible long-term economic cost benefit to the state of Utah.

Certain factors of the existing community structure would be overwhelmed at the onset. These would include health, fire and police protection.

The project would create some short-term economic gains to nearby employed residents of some southern Utah communities.

One of the most important long-term impacts would be on the community of Page, Arizona. Although Lake Powell recreation facilities are expected to attract visitors at an increasing rate regardless of industrial development in the area, the population influx would probably offset the population decline expected on completion of the Navajo plant construction.

Long-term urban and industrial pollution along with short-term productivity probably would substantially impact aesthetics in the area. There is also the possibility of rapid economic decline within the area after the project has been abandoned. The most significant unanswered question about the new community is what will happen to it after the coal is mined?

Although harder to assess, change in life style would undoubtedly accompany development. Infusion of a different group of people would mix existing values and new life styles. In the long-term, this mixing would lead to development of new values and life styles. In the extreme long-term, the entire state could undergo change as a result of energy-related developments.

CALCULATION OF OIL NEEDED TO PRODUCE 3,000 MEGAWATTS

Determination of the oil required to produce 3,000 MW of power is dependent on heat content of the oil and efficiency of the generating plant. Average figures for these are published; Mineral Industry Surveys, Bureau of Mines, "Crude Petroleum, Petroleum Products, and Natural Gas Liquids," December 1974, page 34, gives average heat content of residual fuel oil as 6,287,000 British thermal units (Btu) per barrel and crude petroleum as 5,608,000 Btu/barrel.

The Statistical Abstract of the United States for 1973 by Bureau of Census, page 512, shows average oil consumption in U.S. power plants as 0.076 gallons per kilowatt-hour (kW-h) of residual oil. Hence, with existing boilers and turbines, average age about 8 years, hourly consumption in a 3,000 MW plant at full operation would be:

$3,000 \times 1,000 \times 0.076 \times 1/42 = 5,440$ barrels of residual oil. Crude oil with equivalent heat value would be:

$$5,440 \text{ barrels} \times \frac{6,287,000}{5,608,000} + 6,098 \text{ barrels}$$

Consumption in a new plant built to efficiently burn high cost oil would be lower. Many present oil-fired plants are used for peaking loads and, therefore, have higher consumption than a base load plant.

Existing coal-fired plants in the United States burn about 10,500 Btu/kW-h and new plants about 9,500 Btu/kW-h.

At 9,500 Btu efficiency, residual oil consumption would be:

$$9,500 \times 42 \times \frac{1}{6,287,000} = 0.0635 \text{ gal/kW-h}$$

Equivalent for crude petroleum would be:

$$.0635 \times \frac{6,287,000}{5,608,000} = 0.0712 \text{ gal/kW-h}$$

Yearly consumption would depend on average operating rate. Kaiparowits assumed 75 percent, so:

0.0713 x 3,000,000 x 24 x 365 x .75 x 1/42 = 33,460,000 barrels of crude oil.

NET ENERGY AVAILABILITY ANALYSIS

During the 35-year life of the project, not more than 16 percent of the potential energy in the coal leased by the participants would actually be converted to electricity. The remaining 84 percent would be permanently lost. That is, about 15.78 quadrillion (10^{15}) Btu of energy altogether would become unrecoverable and would be used in the process of converting the equivalent of about 2.5 quadrillion Btu into electrical energy. This is based on the proposal, using current technology: 50 percent of the coal would be recovered, leaving the rest unrecoverable by present mining techniques; 12.5 percent of total coal would be rejected; and the energy input required to mine, clean and transport coal, and the loss of energy in generating and transmitting electricity would amount to 21.5 percent of the potential energy in the coal. Unless systems of mining coal and generating electricity improve considerably, the potential and real energy not utilized and wasted by the project would be lost forever, and would not be available to future generations. This is not a unique case, however, because the participants propose to use conventional methods which, however inefficient, are the only methods proven and currently available.

The net energy available analysis is based on energy requirements for the Central U.S. Coal Region and developed from data presented in a Department of Interior study published in May 1975, titled Energy Alternatives, A Comparative Analysis.

Basic assumption in the analysis are as follows:

One pound of Kaiparowits coal contains 10,800 Btu or 21.6 trillion (10^{12}) Btu per ton or 259.2 trillion (10^{12}) Btu mined each year, which is equal to 9.072 quadrillion (10^{15}) Btu mined during the life of the project.

		Btu of Energy Lost
Btu no longer recoverable after 35 years of mining	=	9.072×10^{15}
Energy used in mining (4.79×10^{9} Btu for each 10^{12} Btu mined)	=	4.345×10^{13}
Energy used in mine conveyor (2.48×10^{8} Btu for each 10^{12} Btu shipped)	=	2.25×10^{12}
Benefaction of coal (breaking, sizing and washing) (4.29×10^{9} Btu for each 10^{12} Btu processed)	=	3.89×10^{13}
Coal lost through waste (25% x 9.072×10^{15} Btu) (Btu shipped to power plant = 6.804×10^{15})	=	2.268×10^{15}
Energy used in conveyor from mine to power plant (3.45×10^{8} Btu for each 10^{12} Btu shipped	=	2.35×10^{12}
Energy lost in power plant (.62 x 6.804×10^{15} Btu) (Based on 38 percent efficiency)	=	4.22×10^{15}
Energy lost in transmission line (0.05 x 2.584×10^{15} Btu)	=	1.294×10^{14}
Total energy lost	=	15.78×10^{15}
Energy delivered to market (0.95 x 2.584×10^{15})	=	2.45×10^{15}
		15.5 percent efficiency

It should be noted that the indicated efficiencies would even be lower if the energy expenditures in the analysis could be adequately evaluated and included for operating the limestone quarry, transporting limestone to the power plant and coal mine, transportation of workers to and from the coal mine and power plant, maintenance of transmission lines and efficiency of electrical use in the market area. The proposed Kaiparowits power project is probably no more inefficient than other power projects being proposed.

KAIPAROWITS

ENVIRONMENTAL IMPACT STATEMENT

CHAPTER VII

ANY IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES WHICH WOULD BE INVOLVED IN THE PROPOSED ACTION SHOULD IT BE IMPLEMENTED

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IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES WHICH WOULD BE INVOLVED IN THE PROPOSED ACTION SHOULD IT BE IMPLEMENTED

SUMMARY

Implementation of the project would result in irreversible trends in land and resource uses and environmental impacts, and irretrievable losses of resources. Some irreversible and irretrievable commitments would have effects throughout the 35-year proposed life of the project, with some expectation of return to preproject conditions after abandonment of the project. Others would have effects for longer periods, and some commitments would be permanent.

Air quality and visibility would be reduced during the life of the project. A total of 840 million tons of coal would be irretrievably lost. Half of this would be mined for use in the generating station, and the remaining half would be left in place for safety and technological reasons, and would be unrecoverable. The project would also require the irretrievable commitment of 1,600,000 cubic yards of aggregate, 6.8 million tons of limestone, 6.3 million gallons of diesel fuel, 42 million gallons of fuel oil, 58.3 million gallons of gasoline, 55,000 tons of steel, 11,000 tons of concrete, and unspecified quantities of other construction materials.

Disruption of aquifers and subsidence caused by mining would be permanent. About 60,000 acre-feet of water would be committed annually for use on the project and new town, and would not be available for other uses for the period of the project existence. Losses of archaeological, historical, and paleontological values would be permanent. Aesthetic intrusions of facilities on 8,941 acres would last at least as long as the project, and perhaps longer.

Recreation use could be excluded from 9,160 acres of government land transferred to private ownership. The expected additional population of 14,000 would result in average increases of 13,700 man-days of hunting, 15,000 man-days of fishing, and 40,000 man-days of off-road vehicle use each year. This would irreversibly alter the present wild and semiwild character of much of the area to more intensified uses, prohibit future establishment of wilderness and primitive areas, and impact nearby national parks and existing wilderness and primitive areas.

Forage loss on more than 12,000 acres, including 4,431 acres to be occupied by man-made structures, would reduce grazing by wildlife and up to 91,805 animal unit months for the life of the project. Reduction of grazing would last even longer. However, the total loss cannot be predicted.

The project itself would result in an average of three to six fatalities a year, and greater numbers of disabling injuries. Expanding social systems could require commitment of additional land, and result in new lifestyles in the area. The project could also encourage additional development in the market areas, which would be irreversible.

INTRODUCTION

Implementation of the project would result in commitments to use the area more intensively and would significantly alter the use of various resources. The use and consumption of land and resources would be irreversible (once initiated, use and impacts would continue and could not be reversed for a long time, if at all) or irretrievable (irrecoverable for a long period of time or permanently). Irreversible refers to trends; irretrievable refers to loss of resources for other uses. Some commitments are both irreversible and irretrievable.

Soils, vegetation, wildlife, and present land uses at the proposed sites would be irreversibly committed during the life of the project and thereafter until they may be reestablished. Air and water would be irreversibly committed during the life of the project to the extent that air quality would be degraded and water used by the project would not be available for other uses. A major irretrievable commitment would be the loss of 840 million tons of coal, which would be permanently lost and therefore not available to future generations. Cultural values, construction materials, fuels and any loss of human life would also be irretrievable if the project should be implemented.

This chapter summarizes and quantifies where possible these types of resource commitments for the entire project to provide a total picture of what implementation of the project would involve.

AIR QUALITY

Although a renewable resource, during the life of the project air quality and visibility would be reduced. This change is not irreversible; however, the loss of clean, clear air during the project life would be irretrievable, particularly to Glen Canyon National Recreation Area and Bryce Canyon and Capitol Reef national parks.

MINERAL RESOURCES

The major commitment of resources would be 840 million tons of coal over the projected 35-year project life. Of this total 420 million tons would be mined and utilized in power production with 315 million tons consumed and 105 million tons lost in washing and placed in the refuse dump. The remaining 420 million tons would be left in place for safety and other reasons and would not be recoverable at a later date. The total commitment of coal resources represents about 10.5 percent of known reserves in the Kaiparowits Plateau coal field.

The large amounts of sand, gravel and other types of aggregate material -- 1,600,000 cubic yards for the new town, highway, power plant, coal mine, and transmission system - that would be used are for all practical purposes irretrievable, because replacement under prevailing natural conditions may take centuries. Mining and consumption of an estimated 6.8 million tons of limestone which would, be irretrievable, would require an estimated 6.3 million gallons of diesel fuel that would come from domestic or imported oil sources. The calculation of this amount was based on the following assumptions:

25 diesel trucks - 30 round trips per day - 60 miles one way from quarry plant to plant site on a 5-day week basis at an estimated 5 miles per gallon of diesel fuel.

3,600 miles per day x 250 work days per year x 35 years = 31,500,000 miles ÷ 5 miles per gallon = 6,300,000 gallons.

The plant would also consume an estimated 10 million barrels (42 million gallons) of fuel oil during its projected 35-year life. The fuel oil would be used in the burner ignition system and would have to come from domestic or imported oil sources.

Workers involved in construction and operation of the various facilities would utilize an estimated 58.3 million gallons of gasoline during the 35-year project life. This calculation was based on the following assumptions.

Considering the buildup and decrease in the construction force and the buildup in operation labor force as projected in Chapter I, an average work force of 3,300 individuals was assumed.

Based on the expected distribution of employees as discussed, it was assumed that 3/4 of the force would live at the new town site and 1/4 would live in Page.

Distance from (one way)

East Clark Bench	to	Generating Station	32 miles
East Clark Bench	to	Mine Site	25
Page	to	Generating Station	49
Page	to	Mine Site	42

Average of two persons per car

5 day per week work

50 weeks per year (2 weeks vacation)

15 miles per gallon gas consumption

35-year life of plant

In addition, unspecified amount of petroleum products would be lost, including lubricants, asphalt, and fuel used in aggregate mining, construction, and patrolling. Construction materials, including concrete, wood, and metals, would also be committed, much of it irretrievably. About 55,000 tons of steel and 11,000 tons of concrete would be used in the project excluding the new town and highway.

WATER RESOURCES

Disruption of aquifers during coal mining activities and subsequent subsidence in mine out areas would be permanent and constitute irreversible and irretrievable commitments. The 121 acre-feet of water for construction of the transmission system and dust control would be lost to other uses including agriculture, recreation, and wildlife. The mine, power plant, new town, and limestone quarry would consume an estimated 60,000 acre-feet of water per year. During the life of the project this would be an irreversible commitment of 1.9 million acre-feet of water that could otherwise be available for other uses. Fifty percent of the water in the new town might be recycled for irrigation purposes, but would then be lost through evaporation. The remainder would not be available for other uses until returned to the Colorado River as treated effluent. Similarly, estimated total increased water use of about 40 acre-feet per year for nearby towns that would experience project-related growth would be unavailable for other uses.

PALEONTOLOGY, ARCHAEOLOGY AND HISTORY

Implementation of the proposed action would involve an irretrievable commitment of paleontological and archaeological values to exploration and investigation under current technical procedures. Once destroyed, these values would not be available for future study. Salvage sites could not be studied with more advanced technological methods which might be developed in the future. Increased population levels would exert additional pressure on these resources, resulting in overuse and destruction. The total number of sites that could be impacted is unknown.

AESTHETICS

Implementation of the proposed action would irreversibly and irretrievably commit the area to a more intensive, industrialized use than at present.

The essentially natural landscape would be altered on approximately 8,941 acres by intrusion of roads, buildings, transmission lines and people. These alterations would irreversibly change the quality of the environment. The natural, open views of unaltered mountains and vegetated slopes would be changed for as long as proposed facilities and the effects of environmental damage exist, which could be until well after project abandonment. Any alteration of landscape by man-made intrusions would be considered irretrievable when viewed from Glen Canyon National Recreation Area and Bryce Canyon and Capitol Reef national parks.

RECREATION

The amount of recreation lands available for use could be reduced by 9,160 acres (total of government land transferred to private ownership, assuming that recreation would be excluded). This in itself would not be a significant irreversible commitment of the recreation resource. However, the approximate increase of 14,000 people in this area and increased recreational use resulting from this population would cause irreversible impacts on the recreation resource. Recreation use would be intensified, i.e., increase of 13,700 man-days of hunting, 15,000 man-days of fishing and 40,000 man-days of off-road vehicle use annually. This would result in a change of character for the recreation resource, from semiprimitive, wild type of use to a more intensified use. This would affect existing nearby national parks, wilderness and primitive areas. This use could cause an irreversible commitment of presently wild and semiwild recreation land to intensified uses and prohibit establishment of future wilderness and primitive areas.

LOST PRODUCTION

Current production on the project area is primarily forage and browse utilized by domestic livestock and wildlife. Project implementation would result in irreversible loss of livestock and wildlife forage on at least 4,431 acres

covered by man-made structures. Irretrievable losses of livestock grazing would amount to 1,541 to 2,623 animal unit months (AUM's) annually or a total of 33,935 to 91,805 AUM's during the projected 35-year project life, depending on how rapidly areas to be reclaimed could be returned to grazing. Forage production on approximately 7,707 acres that would be disturbed during construction and reclaimed would be reduced until reclamation returns the area to current productive levels. This could take upwards of 50 years. The amount of this loss cannot be quantified. Wildlife habitat production on an undeterminable acreage would be irretrievably lost due to increased human utilization.

LOSS OF POWER AND MATERIALS USED FOR DEVELOPMENT

Construction of 3,000 MW power plant, extraction of coal and construction of 1,440 to 1,476 miles of transmission line would require commitment of liquid fuels, electric power, manpower, machinery, steel and a myriad of lesser items such as blasting chemicals, paper, seed, etc. This material and effort would be irretrievably lost to other uses.

LOSS OF LIFE

Fatal accidents related directly to constructing facilities, mining coal and producing power would occur. Secondary, however, would be fatalities occurring not because of direct mining and power producing activity, but as a result of increased human interaction from population increases. Historical trends for all types of on-the-job fatalities could be cited. Projected future fatality rates are at best speculative, but they have occurred and would be expected to occur as a result of coal and power development. Human resources that would be lost due to mining and traffic accidents, murder, and suicides would, of course, be irretrievable. They would be irreplaceable losses and there would be more than previously occurred in the project development area.

Statistics show that underground coal mining is the most hazardous industry in the United States (United Mine Workers Journal, 1974). Data for the first half of 1974 show that one underground mining fatality occurred for each 4 million tons of coal mined and that one fatality occurred for each 21 million tons of coal transported or processed on the surface (Health and Safety Analysis Center, 1974). Other estimates are higher for underground coal mining (Energy Alternatives: A Comparative Analysis, 1975). These data indicate that three to six fatalities could occur each year. Even greater number of disabling injuries could be expected.

SOCIOECONOMICS

A commitment to use land in a specific way encourages the development of certain social-spatial patterns. These in turn call for commitment of additional lands, and people are locked into expanding social systems that are practically irreversible. The commitment to use resources in the proposed manner would result in an irreversible commitment to a new way of life and lifestyle for the area surrounding the Kaiparowits Plateau. The project would also result in an irreversible change for the Page area from one of a recreation-based economy that could fluctuate to an industrial-based economy which would likely persist for years.

As a result of increased electrical energy some irreversible changes would result in the market areas. Adverse socioeconomic changes are presently occurring and the incremental change which would be caused by this project is not identifiable. This project could encourage additional possibly irreversible development in the areas.

U.S. DEPARTMENT OF THE INTERIOR

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